

PAGE'S WEEKLY



ENGINEERING • ELECTRICITY
SHIPBUILDING & MINING
IRON & STEEL INDUSTRIES

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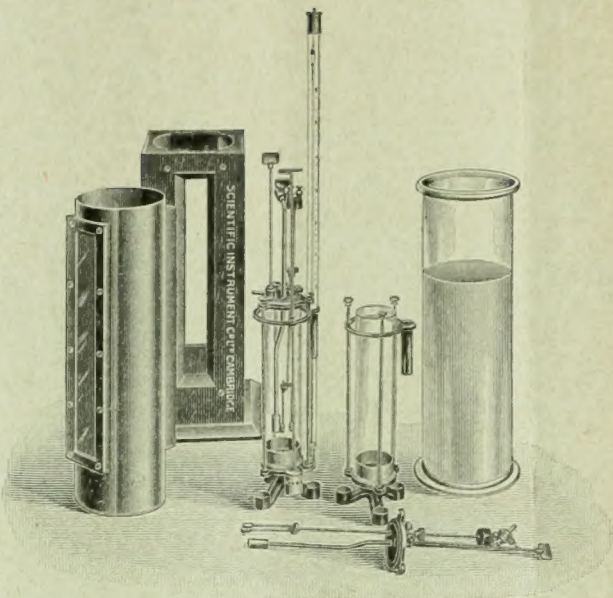
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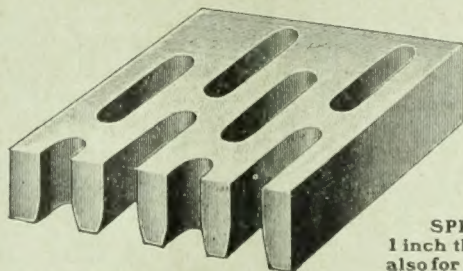
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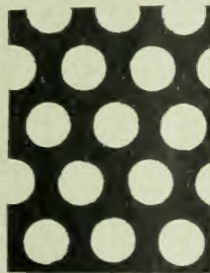
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Miscellaneous

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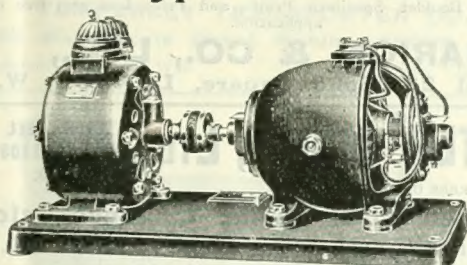
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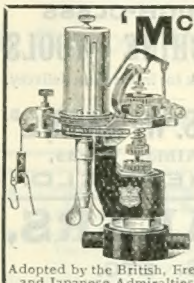
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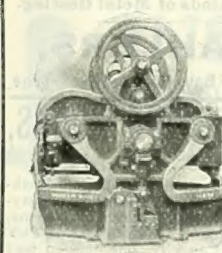
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Miscellaneous

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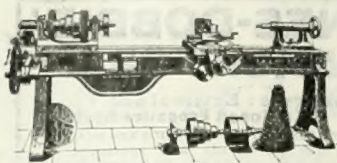
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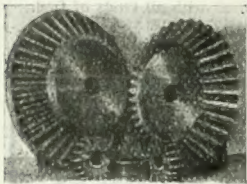
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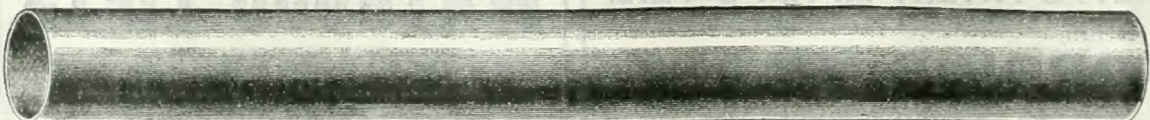
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PAGE'S WEEKLY

Contracts

CONTRACTS.

URBAN DISTRICT OF HORSFORTH.

WATERWORKS.

The Urban District Council of Horsforth invite TENDERS for the CONSTRUCTION and ERECTION of a BOREHOLE PUMP, capable of lifting 9,000 gallons per hour from a depth of 350 ft., for the Horsforth Waterworks, at Scotland Lane, Horsforth.

A plan of the general arrangement of the machinery can be seen, and copies of the General Conditions, Specification, and Tender can be obtained at the offices of the Engineer, Mr. E. J. SILCOCK, M.Inst.C.E., 10, Park Row, Leeds.

Sealed Tenders, endorsed "Borehole Pump," must be delivered to the undersigned not later than noon, Monday, October 16th, 1905.

The Council do not bind themselves to accept the lowest or any Tender.

By order,

ROBERT R. JONES,

Clerk to the Council.

Council Offices,

Horsforth, near Leeds,

September 13th, 1905.

COUNTY OF LONDON.—THE LONDON COUNTY COUNCIL INVITES TENDERS FOR THE SUPPLY OF TWO MOTOR STEAM FIRE ENGINES.

Persons desiring to submit Tenders may obtain the Specification, Form of Tender, and other particulars at the Department of the Clerk of the Council, County Hall, Spring Gardens, S.W., upon payment to the Cashier of the Council of the sum of £1. This amount will, after the Council or its Committee has come to a decision upon the Tenders received, but not before, be returned to the Tenderer provided he shall have sent in a *bona fide* Tender and not have withdrawn the same. Tenders must be upon the official forms, and the printed instructions contained therein must be strictly complied with. The Contractors will be bound by the Contract to pay to all workmen (except a reasonable number of legally bound apprentices) employed by them, wages at rates not less, and to observe hours of labour not greater, than the rates and hours set out in the Council's list; and such rates of wages and hours of labour will be inserted in and form part of the Contract by way of Schedule. Each Tender is to be delivered at the County Hall in a sealed cover, addressed to the Clerk of the London County Council, Spring Gardens, S.W., and marked "Tender for Motor Fire Engines." No Tender will be received after 10 a.m. on Tuesday, the 17th day of October, 1905. Any Tender which does not comply with the printed instructions for Tender may be rejected.

The Council does not bind itself to accept the lowest or any Tender, and it will not accept the Tender of any person or firm who shall on any previous occasion have withdrawn a Tender after the same has been opened, unless the reasons for the withdrawal were satisfactory to the Council.

G. L. GOMME,

Clerk of the London County Council.

Spring Gardens, S.W.,

September 28th, 1905.

COUNTY BOROUGH OF BOURNEMOUTH.

The BOURNEMOUTH TOWN COUNCIL invite TENDERS for the CONSTRUCTION of TWO PASSENGER LIFTS on the East and West Cliffs, Bournemouth.

Full particulars, Forms of Tender, and Specification can be obtained of the Borough Engineer on and after Tuesday, the 25th inst., provided that the sum of £2 2s. has been previously deposited with the undersigned, which deposit shall become forfeited unless a Tender complying with the conditions is sent in, and unless the Form of Tender, Specification, and Conditions and other particulars are returned with the same intact.

Tenders to be sent in, in envelopes provided for the purpose, to the Borough Engineer (Mr. F. W. LACEY, M.Inst.C.E.) before 10 a.m. of Monday, October 16th, 1905.

The Council do not bind themselves to accept the lowest or any Tender.

F. W. LACEY, M.Inst.C.E.,

Borough Engineer and Surveyor.

Municipal Offices, Bournemouth,

September 23rd, 1905.

ADMINISTRATIVE COUNTY OF LONDONDERRY.

The County Council of above-named County invite TENDERS, which must be lodged with me, on or before Thursday, October 19th, 1905, for the SUPPLY and DELIVERY of—

One STEAM ROAD ROLLER.

One ROAD SLEEPING VAN.

One WATER CART.

Specifications for the articles required may be seen, or copies obtained, at the Office of the County Surveyor, County Courthouse, Londonderry. Dated this 20th day of September, 1905.

THOMPSON B. ADAMS,

Secretary to County Council.

County Courthouse, Londonderry.

URBAN DISTRICT OF HORSFORTH.

WATERWORKS.

The Urban District Council of Horsforth invite TENDERS for the CONSTRUCTION and ERECTION of a SUCTION GAS PRODUCING PLANT and GAS ENGINE, capable of producing 32 Brake Horse-power, for the purpose of driving a Bore Hole Pump for the Horsforth Waterworks at Scotland Lane, Horsforth.

A plan of the general arrangement of the machinery can be seen, and copies of the General Conditions, Specification, and Tender can be obtained at the offices of the Engineer, Mr. E. J. SILCOCK, M.Inst.C.E., 10, Park Row, Leeds.

Sealed Tenders, endorsed "Gas Engine," must be delivered to the undersigned not later than noon, Monday, October 16th, 1905.

The Council do not bind themselves to accept the lowest or any Tender.

By order,

Council Offices,

Horsforth, near Leeds,

September 13th, 1905.

ROBT. R. JONES,

Clerk to the Council.

CITY OF NOTTINGHAM.—WATER DEPARTMENT.

TO BRIDGE BUILDERS AND ENGINEERING FIRMS. The Water Committee are desirous of receiving TENDERS for the CONSTRUCTION and ERECTION of a SUSPENSION BRIDGE, 225 ft. span, over the river Trent at Nottingham.

Plans and Specifications may be seen at the office of the Water Engineer, St. Peter's Church Side, Nottingham, on and after Monday next, October 2nd.

Tenders, endorsed "Tender for Suspension Bridge," to be delivered to me at the Guildhall, at or before noon on 17th day of October, 1905.

The Committee do not bind themselves to accept the lowest or any Tender.

By order,

SAMUEL G. JOHNSON,

Town Clerk.

DUBLIN, WICKLOW, AND WEXFORD RAILWAY COMPANY.

TENDERS FOR SLEEPERS.

The Directors of the above Company are prepared to receive TENDERS for the supply of 15,000 9 ft. by 10 in. by 5 in. RECTANGULAR SLEEPERS, to be delivered in March, 1906.

Specifications and Forms of Tender can be had on application to the undersigned.

Tenders, marked "Tenders for Sleepers," and addressed to the Secretary, Dublin, Wicklow, and Wexford Railway, Westland Row Station, Dublin, to be forwarded so as to reach him not later than 10 a.m. on October 25th, 1905.

Westland Row station,

Dublin, September 27th, 1905.

M. F. KEOGH,

Secretary.

DUBLIN, WICKLOW, AND WEXFORD RAILWAY COMPANY.

TENDERS FOR RAILS AND CHAIRS.

The Directors of the above Company are prepared to receive TENDERS for the SUPPLY of 1,000 TONS BULLHEAD STEEL RAILS (85 lb. per lineal yard), with corresponding FISH-PLATES, half to be delivered in May and half in September, 1906; also for the SUPPLY of 650 TONS BULLHEAD CAST-IRON CHAIRS, 200 tons to be delivered in January, 250 tons in April, and 200 tons in July, 1906. Specifications and Forms of Tender can be had on application to the undersigned.

Tenders, marked "Tenders for Rails and Chairs," and addressed to the Secretary, Dublin, Wicklow, and Wexford Railway, Westland Row Station, Dublin, to be forwarded so as to reach him not later than 10 a.m. on October 25th, 1905.

Westland Row Station,

Dublin, September 27th, 1905.

M. F. KEOGH,

Secretary.

STRATFORD-ON-AVON RURAL DISTRICT COUNCIL.

KINETON SEWERAGE.—CONTRACT NO. 1.

The above Council are prepared to receive TENDERS for the CONSTRUCTION of about 4,000 yards of STONEWARE PIPE SEWERS, together with Manholes, Lampholes, and Flushing Chambers in connection therewith; also for the CONSTRUCTION of PUMP WELL, LIQUEFYING TANK, BACTERIA BEDS, ERECTION of ENGINE-HOUSE, and other Works in accordance with the Plans, Sections, Detail Drawings, and Specification prepared by the Engineers.

Plans and Specification may be seen, and Form of Tender and Bills of Quantities obtained at the Offices of the Engineers, Messrs. WILLCOX AND RAIKES, of 63, Temple Row, Birmingham, on or after Wednesday, September 27th, 1905, on payment of a deposit of Five Guineas, which will be refunded on receipt of a *bona fide* Tender and the return of all documents.

Sealed Tenders, on form supplied, and endorsed "Kineton Sewerage," must be delivered at my office not later than 12 o'clock noon on the 20th October, 1905.

The Council do not bind themselves to accept the lowest or any Tender.

By order,

STANLEY C. WARDEN,

Clerk to the Council.

Stratford-on-Avon, September, 1905.

PAGE'S WEEKLY

Contracts and Appointments Open

METROPOLITAN RAILWAY COMPANY. STORES CONTRACT.

The Directors of the Metropolitan Railway Company are prepared to receive TENDERS for the SUPPLY of GENERAL STORES during Twelve Months ending October 31st, 1906.

Manufacturers and others desirous of tendering should apply to the undersigned on or after September 26th, 1905, for a form or forms under the following numbers:—

- No. 1. Acids, Chemicals, Disinfectants, &c.
 2. Asbestos and other Packings.
 3. Axles, Tyres, Springs, Forgings, Steel, Files, &c.
 4. Bolts, Nuts, Rivets, Spikes, Washers, Iron Fencing, &c.
 5. Boots and Clogs.
 6. Brooms, Brushes, Baskets, Mats, and Sponges.
 7. Canvas, Calico, Rope, Twine, Sewing Threads, &c.
 8. Carriage Handles, Hinges, Locks, &c.
 9. Carriage Trimmings, Hair Rugs, Leather Cloth, &c.
 10. Castings, Iron and Malleable.
 11. Cement, Bricks, Pipes, Paving, Slates, Broken Granite, &c.
 12. Cocks, Valves, Sanitary Fittings, Gas Gauges, Gas Burners, &c.
 13. Coke, Gas.
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 15. Copper, Brass, Solder, Spelter, Antimony, &c.
 16. Cotter, Motion and Joint Pins, Studs, &c.
 17. Crucibles and Plumbago.
 18. Electric Lamps, Carbons, Ebonite Fuses, &c.
 19. Electric Wire Casings and Wood Wool.
 20. Electric Wires and Cables.
 21. Felt (Roofing), &c.
 22. Fish-plates.
 23. Fog Signals (Detonating).
 24. Gas and Steam Tubes and Fittings, Steel Boiler Tubes, &c.
 25. Gilt Mouldings.
 26. Glass Lenses, Chimneys, Bends, Gauge Tubes, &c.
 27. Glass: Plate, Sheet, Coloured, &c.
 28. Handles, Hammer, &c., Coupling Poles, Ladders, Scaffolding, Barrows, &c.
 29. Incandescent Gas Fittings, Mantles, &c.
 30. India-rubber (General), Brake Hose, Waterproof Coats, &c.
 31. Iron and Mild Steel Bars, Plates, &c.
 32. Ironmongery: Kettles, Saucepans, Enamelled Reflectors, &c.
 33. Ironmongery: Locks, Hinges, Screws, &c.
 34. Keys, Trenails, Wood Fencing, &c.
 35. Lamps, Tinware, Plated Reflectors, &c.
 36. Lead: Pig, Pipe, Sheet, White, Red.
 37. Leather Hides and Skins (including Chamois).
 38. Meters, Gas and Water.
 39. Nails, Tacks, Panel Pins, Chain, &c.
 40. Oils, Burning and Lubricating, and Burning Naphtha.
 41. Pipes: Iron Socket and Rain-water, Ranges, &c.
 42. Sand, Gravel, and Picked Flints.
 43. Signal Ironwork, Switch Boxes, Wire Pulleys, &c.
 44. Soap, Grease, Tallow, Turpentine, Spirit, Tar, Pitch, &c.
 45. Telegraph Fittings, Battery Jars, Zincs, Insulators, &c.
 46. Timber: Deals, creosoted, Telegraph Poles, Jarrah, Sawdust, &c.
 47. Timber: Teak, Mahogany, Oak, Ash, Telegraph Arms, &c.
 48. Tools: Shovels, Hammers, Picks, Saws, Augers, &c.
 49. Transfers and Transparencies.
 50. Waste (Cotton), Flannel, Sponge, Cloths, Towels, Flags, and other soft goods.
 51. Waterproof Oilskins, Tarpaulins, &c.
 52. Whiting, Glue, Emery Cloths, Matches, &c.
 53. Wire: Iron, Galvanised Strand, &c.
 54. Zinc, Tin-plates, Galvanised Sheets and Holloware, Sieves, &c.
- After the forms have been obtained, samples and patterns of articles and goods may be seen at the office of the Company's Storekeeper, adjoining Neasden Station, N.W., from Monday, October 2nd, to Saturday, October 7th, both days inclusive.
- Tenders, on the forms supplied by the Company only, and endorsed "Tender for" must reach the Secretary not later than 10 a.m. on Monday, October 9th.
- The Directors do not bind themselves to accept the lowest or any Tender.
- R. H. SELBIE, Secretary.
Secretary's Office: 32, Westbourne Terrace, London, W.

BARNES DISTRICT COUNCIL.

ELECTRICITY DEPARTMENT.

The Urban District Council of Barnes invite TENDERS for the Supply, Delivery, and Supervision of Erection of a CONDENSATION WATER PURIFIER and GREASE ELIMINATOR.

Specifications, General Conditions, and Form of Tender can be obtained at the Electricity Works, High Street, Mortlake, S.W.

Tenders, which should be addressed to the undersigned, must be sent in before 12 noon on the 10th October, 1905, marked "Eliminator."

The Council do not bind themselves to accept the lowest or any Tender.

C. S. DAVIDSON, Electrical Engineer.

September 27th, 1905

APPOINTMENTS OPEN.

GEORGE HERIOT'S TRUST.—HERIOT WATT COLLEGE, EDINBURGH. CHEMISTRY DEPARTMENT.

Applications are invited for the post of ASSISTANT PROFESSOR OF CHEMISTRY. Salary £225 per annum.

The successful candidate will be required to take up his duties after the Christmas vacation.

For details of duties apply to the Principal, with whom applications, giving full particulars and accompanied by recent testimonials, must be lodged not later than October 10th.

Edinburgh, September 22nd, 1905.

COUNTY BOROUGH OF WEST HAM.

The Council of the Borough invite applications for the appointment of ELECTRICAL ENGINEER. Candidates must have had previous experience in a similar appointment with a company or corporation supplying electricity under Parliamentary powers, and be competent to design and supervise the construction of the plant, machinery, appliances, and cables necessary to generate and supply electricity for public and private lighting on the high-tension alternating system, also for tramway and power purposes. The gentleman appointed will be required to devote his whole time to the work.

The salary will be £350 per annum, with annual increments of £50 to £500 per annum.

Forms, upon which application for the appointment must be made, may be obtained at my office, and the applications must reach the undersigned not later than Thursday, October 12th, 1905.

Canvassing members of the Council is prohibited.

By Order of the Council.

FRED. E. HILLEARY, Town Clerk.

Town Hall, West Ham, E., Sept. 25th, 1905.

BATTERSEA BOROUGH COUNCIL. CANVASSEER.

The Council require the services of a person with technical knowledge of Electricity. Salary, £2 per week and commission.

Form of Application (containing full particulars) must be obtained from the undersigned, and returned, endorsed "Canvasser," by 12 noon on Tuesday, October 10th.

Personal canvassing will disqualify.

W. MARCUS WILKINS, Town Clerk.

Town Hall, Lavender Hill, S.W., September, 1905.

ELECTRICIAN REQUIRED FOR GOLD COAST RAILWAY.

Will be required to supervise and repair Webb and Thompson's staff instruments, telephones, telegraph instruments (writers and sounders), clocks and watches, and be responsible for maintenance of telegraph line; should also be able to operate a telegraph instrument.

Salary £250 a year, rising annually by £10. Single quarters provided or allowance in lieu. Free first-class passage.

Engagement in first instance for two tours of twelve months' continuous residential service in the Colony. Two months leave on full salary after each tour of twelve months' service if not returning to the Colony, and four months' leave if returning, both exclusive of time spent on voyages. Free passages each way.

Strict medical examination.

Applications, stating age, whether married or single, giving full particulars of experience, and accompanied by copies of testimonials (not originals), with names and addresses of referees of whom inquiry can be made as to capabilities and character, will be received by the Crown Agents for the Colonies, Whitehall Gardens, S.W., up to October 11th.

Any further information can be obtained from the Consulting Engineers, Messrs. PREECE AND CARDEW, 8, Queen Anne's Gate, S.W.

PORTSMOUTH EDUCATION COMMITTEE (HIGHER EDUCATION). MUNICIPAL TECHNICAL INSTITUTE.

The Committee invite APPLICATIONS for the POSITION of ASSISTANT LECTURER for CIVIL ENGINEERING.

Salary £125 per annum, rising by £5 increments to £150.

Applications and Particulars to be obtained from the PRINCIPAL at the Technical Institute, to whom forms should be returned not later than Tuesday, October 10th.

BUYERS' DIRECTORY.

NOTE.—The display advertisements of the firms mentioned under each heading can be found readily by reference to the Alphabetical Index to Advertisers on pages 22 and 24.

In order to assure fair treatment to advertisers, each firm is indexed under its leading speciality ONLY.

Advertisers who prefer, however, to be entered under two or more different sections can do so by an annual payment of 5s. for each additional section.

Advertisers' Service Bureau.

British Advertiser Service Bureau, Queen Anne's Chambers, Westminster, S.W.

Artesian Well Machinery.

John Z. Thom, Patricroft, Manchester.

Beltting.

Binney & Son, Catherine Street, City Road, London, E.C.
Cort, Arthur, & Co., Camberwell, London, S.E.
Fleming, Birkby & Goodall, Ltd., West Grove, Halifax.
Gilmour, W. & O., St. John's Hill, Edinburgh.

Boilers.

Clayton, Son & Co., Ltd., Leeds City Boiler Works, Leeds.
Grantham Boiler and Crank Co., Ltd., Grantham.
Hartley & Sugden, Ltd., Halifax.
Thompson, John, Wolverhampton.

Boilers (Water-tube).

Babcock & Wilcox, Ltd., Oriel House, Farringdon Street, London, E.C.
Stirling Boiler Co., Ltd., Motherwell, N.B.

Bolts, Nuts, Rivets, etc.

Herbert W. Periam, Ltd., Floodgate Street Works, Birmingham.
T. D. Robinson & Co., Ltd., Derby.

Books.

Griffin, Charles, & Co., Exeter Street, Strand, W.C.
New Zealand Mines Record, Wellington, New Zealand.
Spon, E. & F. N., 125, Strand, W.C.

Boring Machines.

Asquith, William, Ltd., Well Road Works, Halifax.
Niles-Bement-Pond Co., 23-25, Victoria Street, London, S.W.

Case-Hardening Compounds.

Hy. Miller & Co., Millgarth Works, Leeds.

Castings.

Ashmore, Benson, Pease & Co., Ltd., Stockton-on-Tees.

Catalogues, Printing, &c.

Atlantic Press, Ltd., Weymouth Street, Manchester.
Spottiswoode Advertising Agency, Clun House, Surrey Street, Strand, W.C.
Stafford, Arthur, & Co., Denton, Manchester.

Chucks.

Fairbanks Co., 78-80, City Road, London, E.C.

Cisterns, Tanks, &c.

Ashmore, Benson, Pease & Co., Ltd., Stockton-on-Tees.
F. A. Keep, Juxon & Co., Barn Street, Birmingham.

Clutches (Friction).

David Bridge & Co., Castleton Ironworks, Rochdale, Lancashire.

Coke Oven Expert.

Mallmann, P. J., 110-118, Victoria Street, S.W.

Colliery Plants.

Graham, Morton & Co., Ltd., Leeds.

Condensing Plant.

Benn, Sykes, Haslingden, near Manchester.
Concentric Condenser, Ltd., 23, Northumberland Avenue, London, W.C.
Mirreles-Watson & Co., Ltd., Glasgow.

Consulting Engineers.

Gibbs, John, & Son, 80, Juke Street, Liverpool.
G. H. Hughes, A.M.I.M.E., 12, Old Queen Street, Westminster, S.W.
Melville & Macalpine, 615, Walnut Street, Philadelphia, Pa., U.S.A.

Continental Railway Arrangements.

Northern Railway of France.
South Eastern & Chatham Railway Co.

Conveying and Elevating Machinery.

Adolf Bleichert & Co., Leipzig-Gohlis, Germany.
Fraser & Chalmers, Ltd., 3, London Wall Buildings, London, E.C.
Temperley Transporter Co., 72, Bishopsgate Street Within, London, E.C.

Coverings (Boiler).

Magnesla Coverings, Ltd., Washington Station, co. Durham.

Cranes, Travellers, Winches, etc.

Joseph Booth & Bros. Ltd, Rodley, Leeds.
Thomas Broadbent & Sons, Ltd., Huddersfield.
Niles-Bement-Pond Co., 23-25, Victoria Street, London, S.W.

Cranks.

Clarke's Crank & Forge Co., Ltd., Lincoln, England.

Cutters (Milling).

Pratt & Whitney Co., 23-25, Victoria Street, London, S.W.
E. G. Wrigley & Co., Ltd., Foundry Lane Works, Soho, Birmingham.

Destructors.

Heenan & Froude, 4, Chapel Walks, Manchester.
Horsfall Destructor Co., Ltd., Armley, Leeds.

Dredges and Excavators.

Delange & Cie, Mce., Hoboken, near Antwerp.
Rose, Downs & Thompson, Ltd., Old Foundry, Hull.

Drilling Machines.

Asquith, William, Ltd., Well Road Works, Halifax.
Niles-Bement-Pond Co., 23-25, Victoria Street, London, S.W.
Swift, George, Claremont Ironworks, Halifax.

Economisers.

E. Green & Son, Ltd., Manchester.

Ejectors (Pneumatic).

Hughes & Lancaster, 16, Victoria Street, London, S.W.

Electrical Apparatus.

Allgemeine Elektrizitäts Gesellschaft, Berlin, Germany.
Broadbent, T. W., Victoria Electrical Works, Huddersfield.
Crypto Electrical Co., 3, Tyer's Gateway, Bermondsey Street, London, S.E.
Ebonestos Manufacturing Co., 22, Rosoman Street, London, E.C.
Gent & Co., Ltd., Faraday Works, Leicester.
Greenwood & Bailey, Ltd., Albion Works, Leeds.
India Rubber, Gutta Percha, and Telegraph Works Co. Ltd., Silvertown, London, E.
Mather & Platt, Ltd., Salford Iron Works, Manchester.
Matthews & Yates, Ltd., Swinton, Manchester.
Mix and Genest, Berlin, W., Germany.
Nalder Bros. & Thompson, 34, Queen Street, London, E.C.
New Gutta Percha Co., Ltd., Dashwood House, New Broad Street, E.C.
Newton Brothers, Full Street, Derby.
Phoenix Dynamo Manufacturing Co., Bradford, Yorks.
Sturtevant Engineering Co., Ltd., 147, Queen Victoria Street, London, E.C.
Turner, Atherton & Co., Ltd., Denton, Manchester.
B. Weaver & Co. (see Ebonestos Manufacturing Co.), 22, Rosoman Street, Clerkenwell, London, E.C.

Engineers' Supplies.

Ahlers, Ad., Whitley Bay, near Newcastle-on-Tyne.

Engines (Gas).

Campbell Gas Engine Co., Ltd., Halifax.
Soest, L., & Co., Ltd., 114-116, Victoria Street, London, S.W.
Cundall, Sons & Co., Ltd., Airedale Iron Works, Shipley.

Engines (Electric Lighting).

McLaren, J. and H., Midland Engine Works, Leeds.

Engines (Locomotive).

Baldwin Locomotive Works, Philadelphia, Pa., U.S.A.
Hunslet Engine Co., Ltd., Leeds, England.
Hudswell, Clarke & Co., Ltd., Leeds, England.
McLaren, J. & H., Midland Engine Works, Leeds.

Engines (Portable).

Garrett, R., & Sons, Leiston, R.S.O., Suffolk.

Engines (Stationary).

Allis-Chalmers Co., 533, Salisbury House, Finsbury Circus, London, E.C.
Fraser & Chalmers, Ltd., 3, London Wall Buildings, London, E.C.
Garrett, R., & Sons, Leiston, R.S.O., Suffolk.
Mirreles-Watson Co., Ltd., Glasgow.

Engines (Traction).

Jno. Fowler & Co. (Leeds) Ltd., Steam Plough Works, Leeds.
Garrett & Sons, Ltd., Richard, Leiston, R.S.O., Suffolk.

Engravers.

Jno. Swain & Son, Ltd., 58, Farringdon Street, London, E.C.

Exhaust Steam Oil Separators.

Lancaster & Tonge, Ltd., Pendleton, Manchester.

Fans, Blowers.

Capel Fan Co., 13, Moseley Street, Newcastle-on-Tyne.
Davidson & Co., Ltd., "Sirocco" Engineering Works, Belfast, Ireland.
Gibbs, John & Son, 80, Juke Street, Liverpool.
James Keith & Blackman Co., Ltd., 27, Farringdon Avenue, London, E.C.
Matthews & Yates, Ltd., Swinton, Manchester.

Fire Bricks.

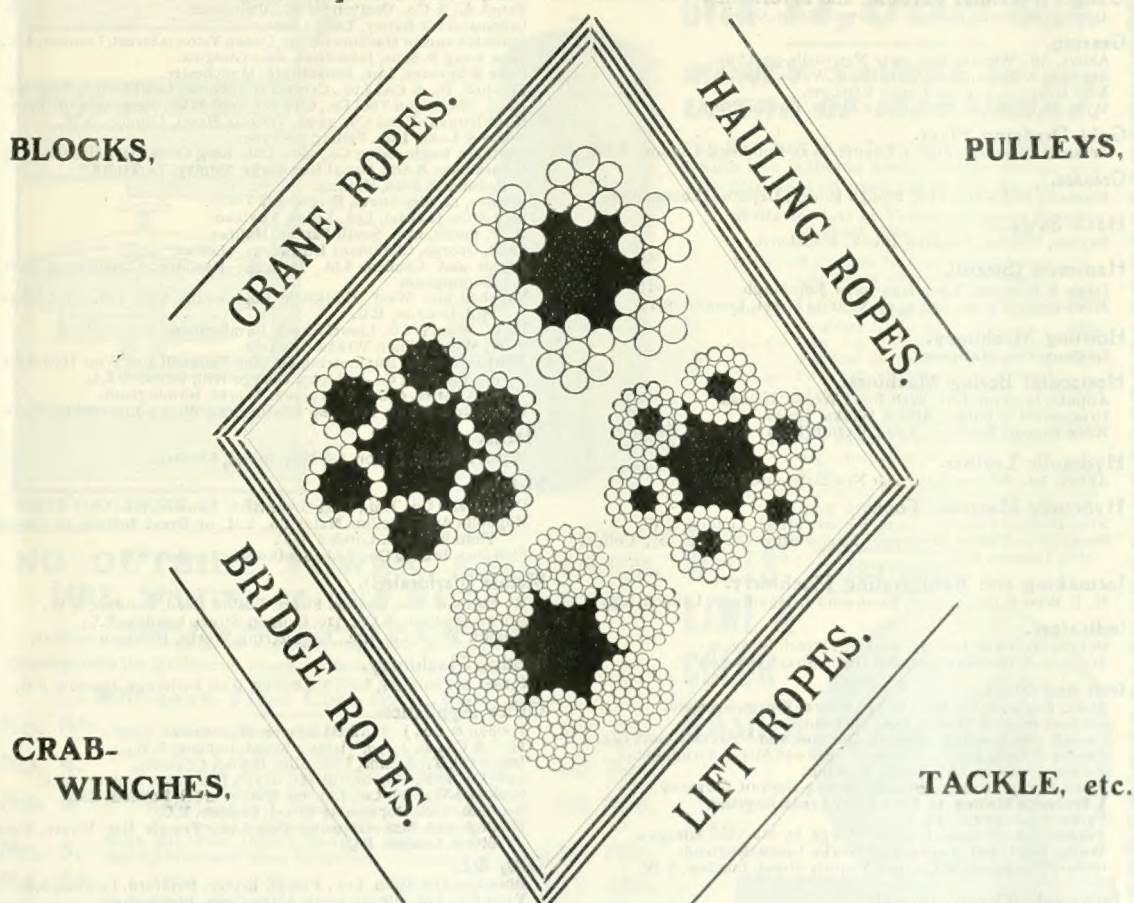
J. H. Sankey & Son, Ltd., Essex Wharf, Canning Town, London, E.



BULLIVANTS'

Steel Wire Mining Ropes.

Wire Ropes for Hauling and Winding Gear,
and all operations connected with Mining.



*Stronger, Lighter, and Cheaper than Hemp Rope or Chain, and
ABSOLUTELY RELIABLE.*

A Piece of every Mining Rope tested to Destruction, and a Test Certificate Supplied.

BULLIVANT & CO., Ltd., Registered Offices: 72, Mark Lane, London.
Telephone No.: 2110 AVENUE. WRITE FOR PAMPHLET M.H. Works: MILLWALL, E.

Buyers' Directory—(Continued).

Firewood Machinery.

M. Glover & Co., Patentees and Saw Mill Engineers, Leeds.

Fountain Pens.

Mable, Todd & Bard, 93, Cheapside, London E.C.

Forging (Drop) Plants.

Brett's Patent Lifter Co., Ltd., Coventry.

Forgings (Drop).

J. H. Williams & Co., Brooklyn, New York, U.S.A.

Furnaces.

Deighton's Patent Flue & Tube Company, Vulcan Works, Pepper Road, Leeds.

Leeds Forge Co., Ltd., Leeds.

Masons Gas Power Co., Ltd., Alma Works, Levenshulme, Manchester.

Gas Producers.

Graham, Morton & Co., Ltd., Leeds.

Masons Gas Power Co., Ltd., Alma Works, Levenshulme, Manchester.

Gauge Glasses.

J. B. Treasure & Co., Vauxhall Road, Liverpool.

Tomey, J., & Sons, Aston, Birmingham.

Gauges (Pressure, Vacuum, and Hydraulic).

Dobbie, McInnes, Ltd., 45, Bothwell Street, Glasgow.

Gearing.

Ahlers, Ad., Whitley Bay, near Newcastle-on-Tyne.

Asquith, William, Ltd., Well Road Works, Halifax.

Reid Gear Co., Linwood, near Glasgow.

Wild, M. B., & Co., Corporation Street, Birmingham.

Gold Dredging Plant.

Fraser & Chalmers, Ltd., 3, London Wall Buildings, London, E.C.

Greases.

Blumann and Stern, Ltd., Plough Bridge, Deptford, London, S.E.

Hack Saws.

Baynes, Charles, Knuzden Brook, Blackburn.

Hammers (Steam).

Davis & Primrose, Leith Ironworks, Edinburgh.

Niles-Bement Pond Co., 23-25, Victoria Street, London, S.W.

Hoisting Machinery.

See Conveying Machinery.

Horizontal Boring Machines.

Asquith, William, Ltd., Well Road Works, Halifax.

Greenwood & Batley, Albion Works, Leeds.

Niles-Bement Pond Co., 23-25, Victoria Street, London, S.W.

Hydraulic Leather.

Ahlers, Ad., Whitley Bay, near Newcastle-on-Tyne.

Hydraulic Machine Tools.

Niles-Bement Pond Co., 23-25, Victoria Street, London, S.W.

Vauxhall and West Hydraulic Engineering Co., Ltd., 23, College Hill, London, E.C.

Icemaking and Refrigerating Machinery.

H. J. West & Co., 114-118, Southwark Bridge Road, London, S.E.

Indicators.

Dobbie McInnes, Ltd., 45, Bothwell Street, Glasgow.

Hannan & Buchanan, 75, Robertson Street, Glasgow.

Iron and Steel.

Allen, Edgar, & Co., Ltd., Imperial Steel Works, Sheffield.

Askham Bros. & Wilson, Ltd., Sheffield.

Consett Iron Co., Ltd., Consett, Durham, and Newcastle-on-Tyne.

Fairley & Sons, James, Old Mint, Shadwell Street, Birmingham.

Farnley Iron Co., Ltd., Leeds, England.

Fried. Krupp, Grusonwerk, Magdeburg-Buckau, Germany.

J. Frederick Melling, 14, Park Row, Leeds, England.

Parker Foundry Co., Derby.

Purden, John & Sons, Lambhill Forge, by Maryhill, Glasgow.

Walter Scott, Ltd., Leeds Steel Works, Leeds, England.

Gilbert Thompson & Co., 116, Victoria Street, London, S.W.

Ironwork (Constructional).

F. A. Keep, Juxon & Co., Barn Street, Birmingham.

Ironwork (Galvanised).

F. A. Keep, Juxon & Co., Barn Street, Birmingham.

Lagging Sheets.

Zeitz & Co., 21, Lime Street, London, E.C.

Lathes.

Asquith, William, Ltd., Well Road Works, Halifax.

Bradbury & Co., Ltd., Wellington Works, Oldham.

Eclipse Tool Manufacturing Co., Linwood, near Glasgow.

Leckenby, Benton, & Co., Perseverance Ironworks, Halifax.

Mitchell, D., & Co., Ltd., Central Ironworks, Lawkholme, Keighley.

Niles-Bement Pond Co., 23-25, Victoria Street, London, S.W.

Northern Engineering Co. (1900) Ltd., King Cross, near Halifax.

Swift, George, Claremont Ironworks, Halifax.

Lathe Carriers.

Williams, J. H., & Co., Brooklyn, New York, U.S.A.

Laundry Machinery.

W. Summerscales & Sons, Ltd., Engineers, Phoenix Foundry, Keighley, England.

Lifts.

Waygood & Co., Ltd., Falmouth Road, London, S.E.

Lubricants.

Blumann & Stern, Ltd., Plough Bridge, Deptford, London, S.E.

Reliance Lubricating Oil Co., The, 19 & 20, Water Lane, Great Tower Street, London, E.C.

Matthew Wells & Co., Hardman Street Oil Works, Manchester.

Machine Tools.

Asquith, William, Ltd., Well Road Works, Halifax.

George Addy & Co., Waverley Works, Sheffield.

Bateman's Machine Tool Co., Hunslet, Leeds.

Bertrams, Ltd., St. Katherine's Works, Sciennes, Edinburgh.

Bradbury & Co., Ltd., Wellington Works, Oldham.

Breuer, Schumacher & Co., Ltd., Kalk, near Cologne-on-Rhine (Germany).

Consolidated Pneumatic Tool Co., Ltd., Palace Chambers, 9, Bridge Street, Westminster, S.W.

Cunliffe & Croom, Ltd., Broughton Ironworks, Manchester.

Dean, Smith & Grace, Ltd., Keighley.

Fengl, A., & Co., Grafton Street, Altrincham.

Greenwood & Batley, Ltd., Leeds.

Jones & Lamson Machine Co., 97, Queen Victoria Street, London, E.C.

John Lang & Sons, Johnstone, near Glasgow.

Luke & Spencer, Ltd., Broadheath, Manchester.

Mitchell, D., & Co., Ltd., Central Ironworks, Lawkholme, Keighley.

Jos. C. Nicholson Tool Co., City Rd. Tool Wks., Newcastle-on-Tyne.

Niles-Bement Pond Co., 23-25, Victoria Street, London, S.W.

Noble & Lund Ltd., Felling-on-Tyne.

Northern Engineering Co., 1900, Ltd., King Cross, near Halifax.

J. Parkinson & Son, Canal Ironworks, Shipley, Yorkshire.

C. Redman & Sons, Halifax.

Resides, 12, Aire Street, Brighouse, Yorks.

Rice & Co. (Leeds), Ltd., Leeds, England.

G. F. Smith, Ltd., South Parade, Halifax.

Swift, George, Claremont Ironworks, Halifax.

Taylor and Challen, Ltd., Derwent Foundry, Constitution Hill, Birmingham.

Vauxhall and West Hydraulic Engineering Co., Ltd., 23, College Hill, London, E.C.

H. W. Ward & Co., Lionel Street, Birmingham.

T. W. Ward, Albion Works, Sheffield.

West Hydraulic Engineering Co. (see Vauxhall and West Hydraulic Engineering Co., Ltd.), 23, College Hill, London, E.C.

Winn, Charles, & Co., St. Thomas Works, Birmingham.

Yorkshire Machine Tool and Engineering Works, Liversedge, Yorks.

Marks.

Pryor, Edward, & Son, 68, West Street, Sheffield.

Metals.

Delta Metal Co., Ltd., East Greenwich, London, S.E.

Magnolia Anti-Friction Metal Co., Ltd., of Great Britain, 49, Queen Victoria Street, London, E.C.

Phosphor Bronze Co., Ltd., Southwark, London, S.E.

Metals (Perforated).

W. Barnes & Son, Chalfon Street, Easton Road, London, N.W.

Brown, Andrew, & Co., 110, Cannon Street, London, E.C.

Meguinn, Fr., & Co., Ltd., Engineering Works, Dillingen-on-Saar.

Mining Machinery.

Fraser & Chalmers, Ltd., 3, London Wall Buildings, London, E.C.

Office Appliances.

Halden & Co., J., 8, Albert Square, Manchester.

Hall & Co., E. J., 39, Victoria Street, London, S.W.

Inglesant, T., & Sons, Ltd., Atlas House, Leicester.

Lyle Co., Ltd., Harrison Street, Gray's Inn Road, London, W.C.

Rookwell-Wabash Co., Ltd., 69, Milton Street, London, E.C.

Shannon, Ltd., Ropemaker Street, London, E.C.

Trading and Manufacturing Co., Ltd., Temple Bar House, Fleet Street, London, E.C.

Oils, &c.

Blumann and Stern, Ltd., Plough Bridge, Deptford, London, S.E.

Valor Co., Ltd., Rocky Lane, Aston Cross, Birmingham.

Wells, M., & Co., Hardman Street Oil Works, Manchester.

Packing.

Beldam Packing & Rubber Co., 93-94, Gracechurch Street, London, E.C.

Frictionless Engine Packing Co., Ltd., Hendham Vale Works, Harpurhey, Manchester.

Lancaster & Tonge, Ltd., Pendleion, Manchester.

Redfern & Co., S. Swan Lane, New Brown Street, Manchester.

Quaker City Rubber Co., Coronation House, Lloyd's Avenue, E.C.

United States Metallic Packing Co., Ltd., Bradford.

J. Bennett von der Heyde, 6, Brown Street, Manchester.

Paper.

Lepard & Smiths, Ltd., 29, King Street, Covent Garden, London, W.C.

Patent Agents.

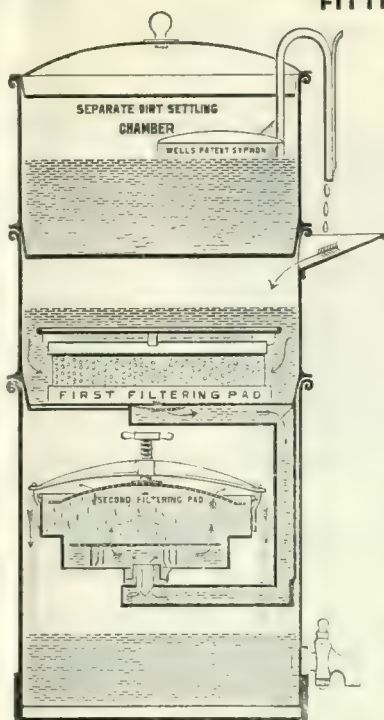
Page & Rowlingston, 28, New Bridge Street, London, E.C.

PAGE'S WEEKLY Wells Specialities

WELLS' PATENT "Waste Oil" FILTERS

FITTED WITH SIGHT-FEED SYPHON.

SUPPLIED TO THE PRINCIPAL GOVERNMENTS FOR
THE NAVY, DOCKYARDS, &c., AND TO THE LEADING
ELECTRIC LIGHT INSTALLATIONS, ENGINEERING
WORKS, GAS ENGINE MAKERS, PRINTERS, &c., &c.



WELLS' PATENT "WASTE OIL" FILTER.



OVER **11,000** SOLD.

**MONEY SAVERS to any
USERS OF MACHINERY.**

Pay first cost in a short time, as Dirtied Oil, which has hitherto been thrown away, can be filtered and used again and again.

Write for List of Testimonials and Samples of Work done by the Filter.

- | | |
|---|------|
| No. 1.—For users having only a small quantity of oil to treat (no syphon) 17 in. by 6 in. | 35— |
| No. 2.—Two top chambers hold about 3 gallons oil, 22 in. by 10 in. | 50— |
| No. 3.—Two top chambers hold about 6 gallons oil, 27 in. by 12 in. | 70— |
| No. 4.—Two top chambers hold about 12 gallons oil, 36 in. by 16 in. | 110— |
| No. 5.—Two top chambers hold about 24 gallons oil, 43 in. by 23 in. | 189— |
| No. 6.—Very powerful Filter for treating large quantities of oil, 54 in. by 30 in. | 336— |

Capable of dealing with 250 Gals. Oil per week.
LARGER SIZES MADE TO ORDER.

NO OUTSIDE POWER REQUIRED. LIME, WHITING, OR COLD WATER PAINTS,

Applied at a speed of from 8 to 10 square yards per minute, in a manner superior to brush work.

One coat with the Machine on rough surfaces is equal to two applied with brushes.

Will save First Cost in a Few Days.

- | | | |
|---------------------------------|--|----------|
| No. 6A. | Small size with Detachable Roll | £5 15s. |
| No. 4. | Price, with 5 ft. Pole, Single Spraying Nozzle, and 20 ft. Special Armoured Hose. Capacity 7 gals. | £8 10s. |
| No. 4A. | Price, with Wheels 5 ft. Pole, Single Spraying Nozzle, and 20 ft. Special Armoured Hose. | £9 10s. |
| Same capacity as No. 4 Machine. | | |
| No. 5. | With 5-ft. Pole, Double Spraying Nozzle, and 20 ft. Special Armoured Hose, Large Size. Capacity 19 gals. | £10 10s. |
| No. 5A. | Ditto Ditto fitted with Wheels | £11 15s. |

WELLS' IMPROVED LIMEWASH.

MUCH SUPERIOR TO ORDINARY LIMEWASH. SLAKED WITH WATER QUICKLY MIXED. WILL NOT RUB OFF. LEAVES A GOOD SURFACE.

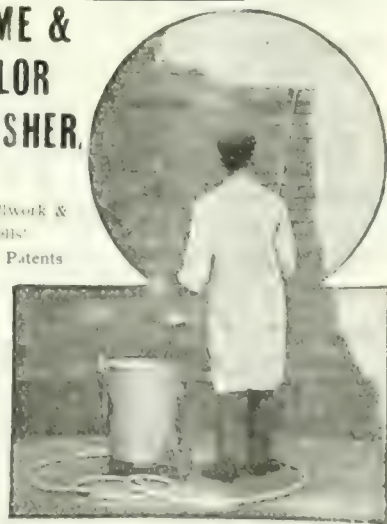
Price 13/8 per cwt.,

Carriage Paid in England and Wales, (If in lots of 3 cwt. at a time, 12/8 per cwt.)

A. C. WELLS & Co.,
100a, Midland Road, St. Pancras,
Works: Cheetham, Manchester. LONDON, N.W.

WELLS' "LIGHTNING" LIME & COLOR WASHER.

Wallwork &
Wells'
Patents



No. 4A, with Wheels.

Buyers' Directory—(Continued).

Photo Copying Frames.

J. Halden & Co., 8, Albert Square, Manchester.
B. J. Hall & Co., 39, Victoria Street, London, S.W.

Photographers.

Booker & Sullivan, 17 and 66, Chancery Lane, W.C.
Elliott & Fry, 55, Baker Street, London, W.

Photographic Apparatus.

Marion & Co., Ltd., 22 and 23, Soho Square, London, W.

Pinch Bars.

Samson & Co., Garforth, near Leeds.

Pipe Wrenches (Chain).

Williams, J. H., & Co., Brooklyn, New York, U.S.A.

Pistons.

Lancaster & Tonge, Ltd., Pendleton, Manchester.

Planished Sheets.

Zeitz & Co., 21, Lime Street, London, E.C.

Porcelain.

Gustav Richter, Charlottenburg, near Berlin, Germany.

Presses (Hydraulic).

Greenwood & Batley, Albion Works, Leeds.
Niles-Bement-Pond Co., 23-25, Victoria Street, London, S.W.

Publishers.

Charles Griffin & Co., Ltd., Exeter Street, Strand, London, W.C.
Spon, E. and F. N., 125, Strand, W.C.
New Zealand Mines Record, Wellington, New Zealand.

Pumps and Pumping Machinery.

Drum Engineering Co., 27, Charles Street, Bradford.
Enke, Carl, Schkeuditz-Leipzig, Germany.
Fraser & Chalmers, Ltd., 3, London Wall Buildings, London, E.C.
J. P. Hall & Sons, Ltd., Peterborough.
Hathorn, Davey & Co., Ltd., Leeds, England.
Positive Rotary Pumps, Ltd., 23, Northumberland Avenue, London, W.C.
Tangyes, Ltd., Cornwall Works, Birmingham.

Radial Drilling Machines.

Asquith, William, Ltd., Well Road Works, Halifax.
Greenwood & Batley, Albion Works, Leeds.
Niles-Bement-Pond Co., 23-25, Victoria Street, London, S.W.
Northern Engineering Co. (1900), Ltd., King Cross, near Halifax.
Swift, George, Claremont Ironworks, Halifax.

Rails.

Wm. Firth, Ltd., Leeds.

Railway Wagons.

Nye, A. W., 110, Cannon Street, London, E.C.
W. R. Renshaw & Co., Ltd., Phoenix Works, Stoke-on-Trent.

Riveted Work.

F. A. Keep, Juxon & Co., Forward Works, Barn Street, Birmingham.

Roller Bearings.

Hyatt Roller Bearing Co., 47, Victoria Street, London, S.W.

Roofs.

D. Anderson & Son, Ltd., Lagan Felt Works, Belfast.
Head, Wrightson & Co., Ltd., Thornaby-on-Tees.

Ropeways (Aerial).

Bullivant & Co., Ltd., 72, Mark Lane, London, E.C.

Scientific Instruments.

Cambridge Scientific Instrument Co., Ltd., Cambridge.

Spanners.

Williams, J. H., & Co., Brooklyn, New York, U.S.A.

Stampings.

Thomas Smith & Sons, of Salford, Ltd., Birmingham.
Williams, J. H., & Co., Brooklyn, New York, U.S.A.

Stamps (Rubber).

Rubber Stamp Co., 1 & 3, Holborn Buildings, Broad Street Corner, Birmingham.

Stamps (Metal).

Edward Pryor & Son, 68, West Street, Sheffield.

Steam Traps.

British Steam Specialties, Ltd., Fleet Street, Leicester.
Lancaster & Tonge, Ltd., Pendleton, Manchester.

Steam Wagons.

Thornycroft & Co., Ltd., J. I., Chiswick, London, W.
Yorkshire Patent Steam Wagon Co., Pepper Road, Hunslet, Leeds.

Steel Tools.

Saml. Buckley, St. Paul's Square, Birmingham.
Pratt & Whitney Co., 23-25, Victoria Street, London, S.W.

Steel Structures.

Alfred Bensen, Foster & Co., Ltd., Stockton-on-Tees.

Stokers.

Ed. Bennis & Co., Ltd., Bolton, Lancs.
Meldrum Brothers, Ltd., Atlantic Works, Manchester.

Stone Breakers.

S. Pegg & Son, Alexander Street, Leicester.

Superheaters.

A. Bolton & Co., 40, Deansgate, Manchester.

Time Recorders.

Howard Bros., 40, Paradise Street, Liverpool, and 100c, Queen Victoria Street, London, E.C.
Recorders, Ltd., 171, Queen Victoria Street, London, E.C.

Tubes.

Premier Boiler Tubes, Ltd., 28, Victoria Street, London, S.W.
Thomas Piggott & Co., Ltd., Spring Hill, Birmingham.
Tubes, Ltd., Birmingham.

Turbines.

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Lassen & Hjort, 52, Queen Victoria Street, London, E.C.

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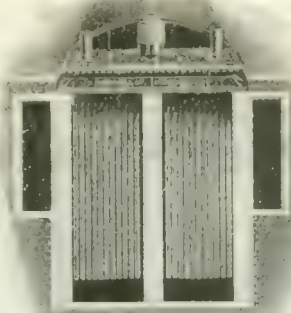
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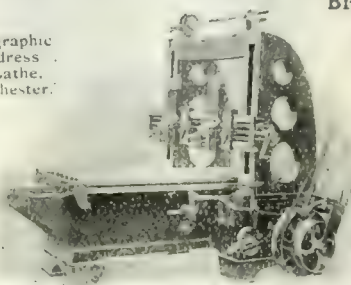
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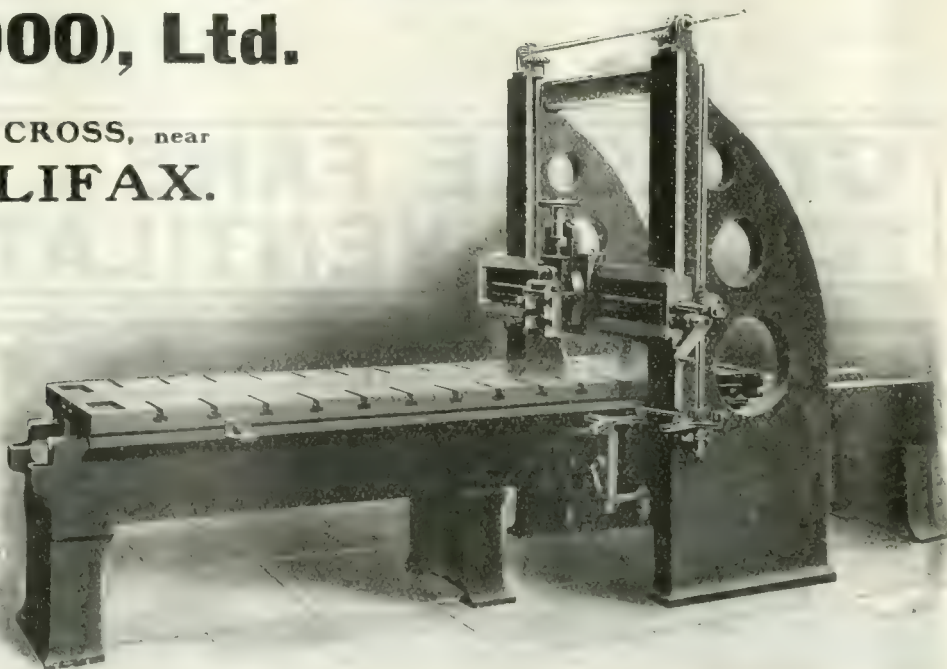
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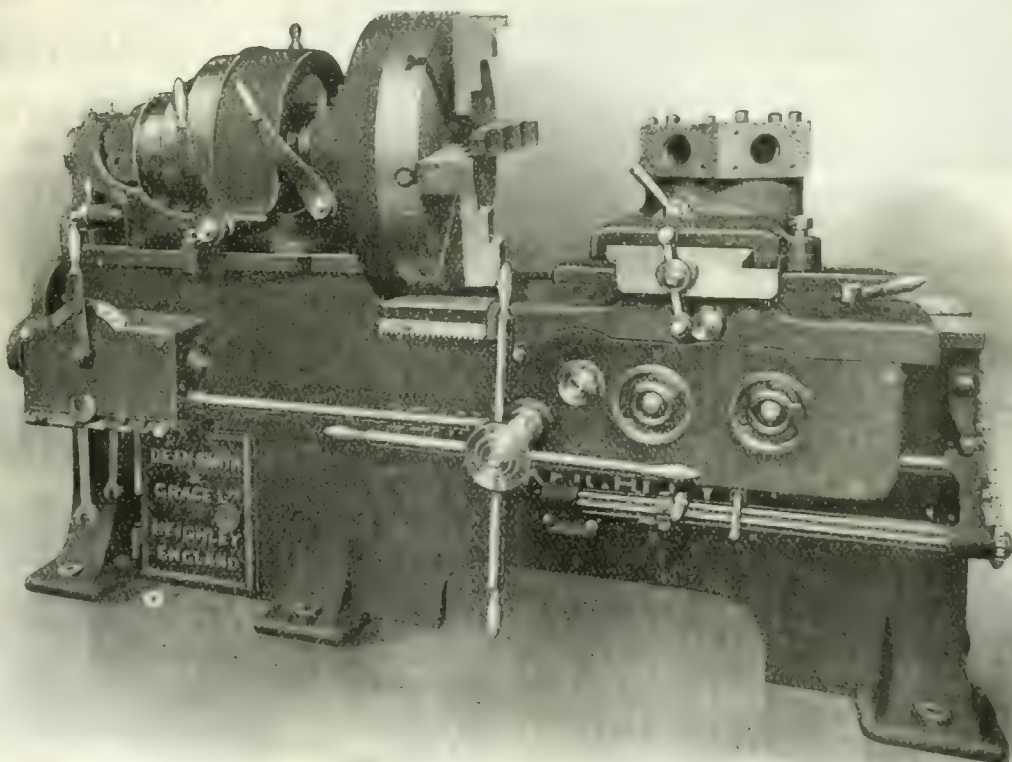
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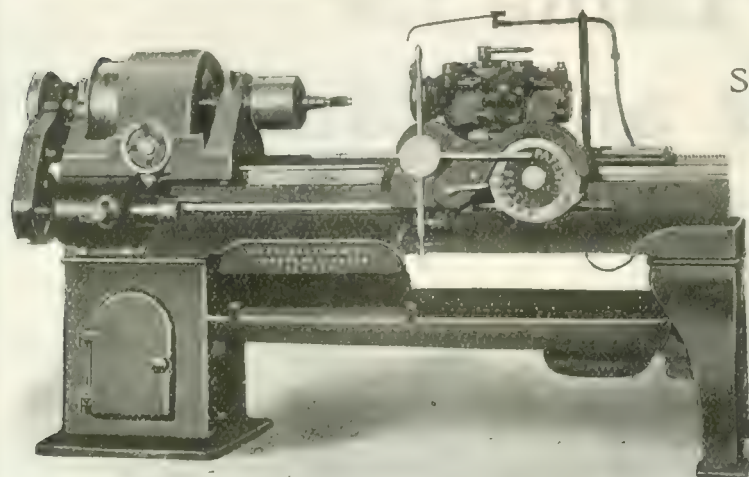
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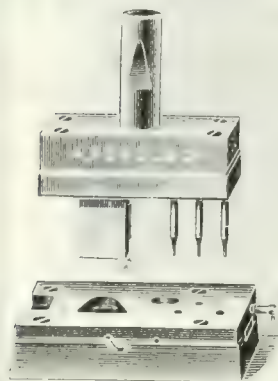
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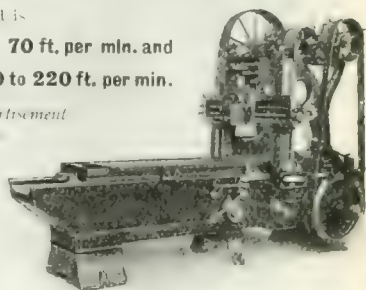
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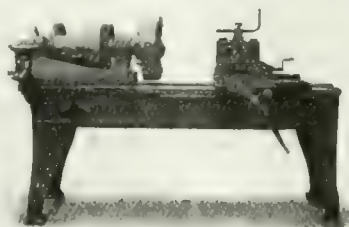
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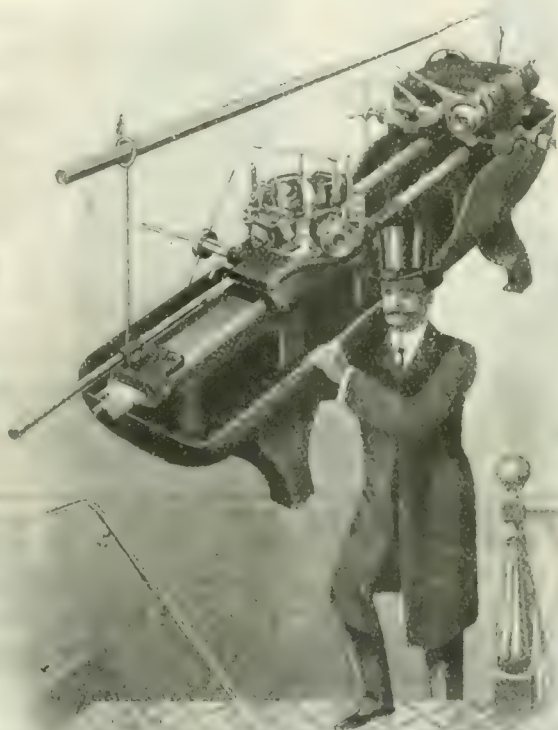
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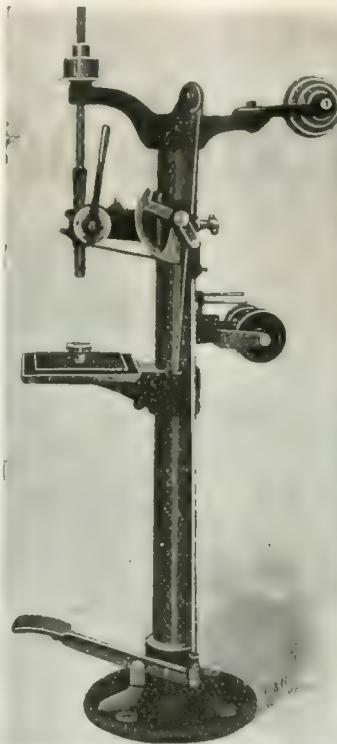
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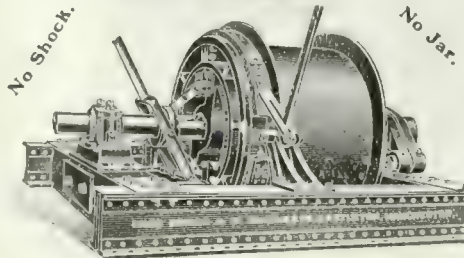
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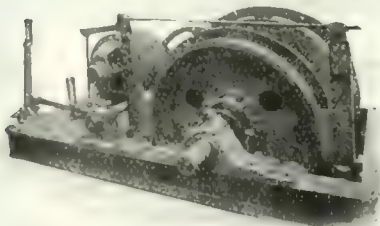
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London Office:

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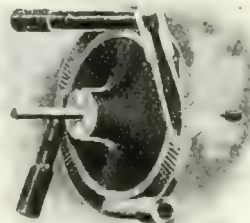
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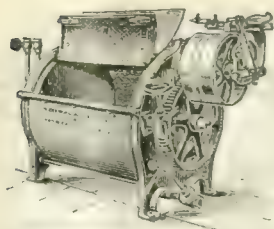


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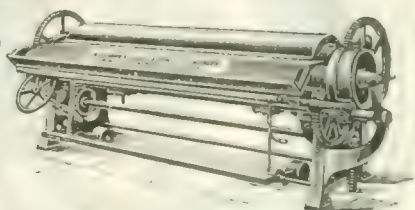
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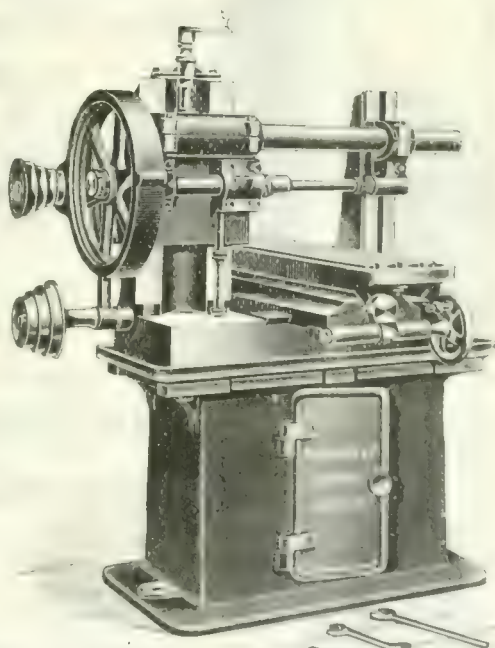
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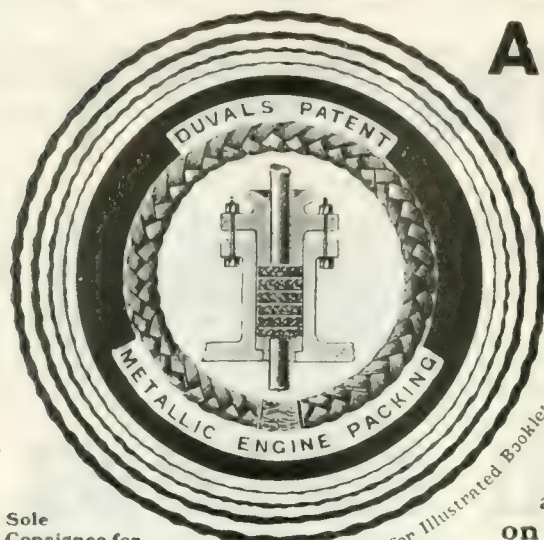


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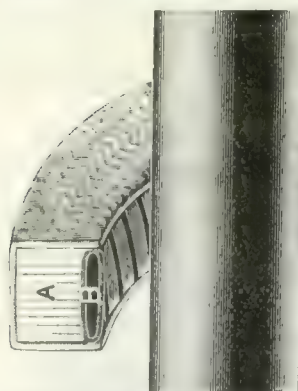
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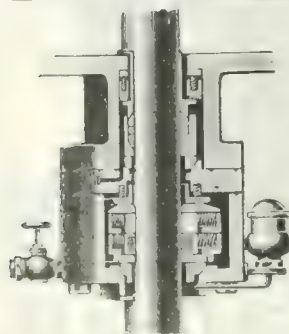
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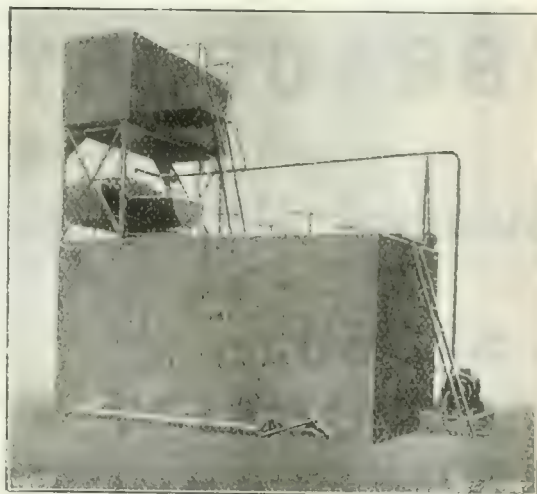
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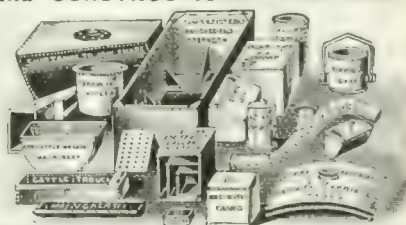
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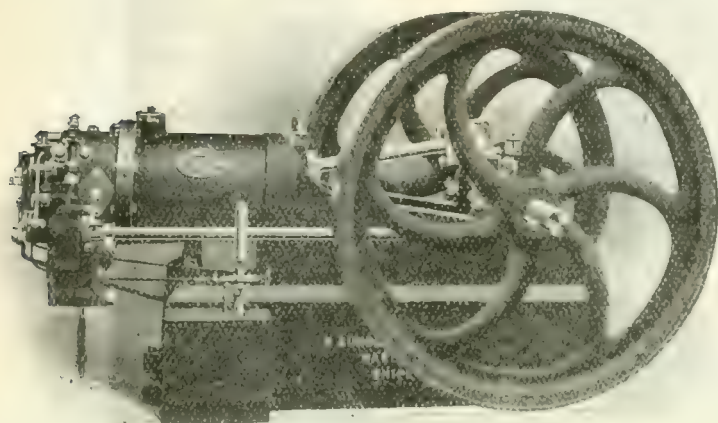


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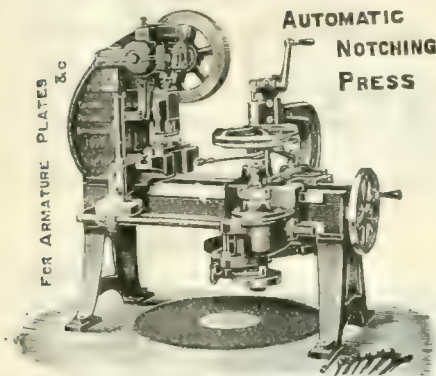
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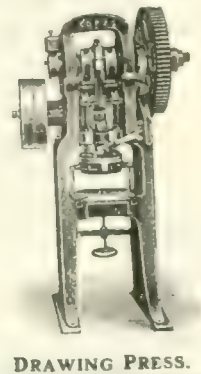
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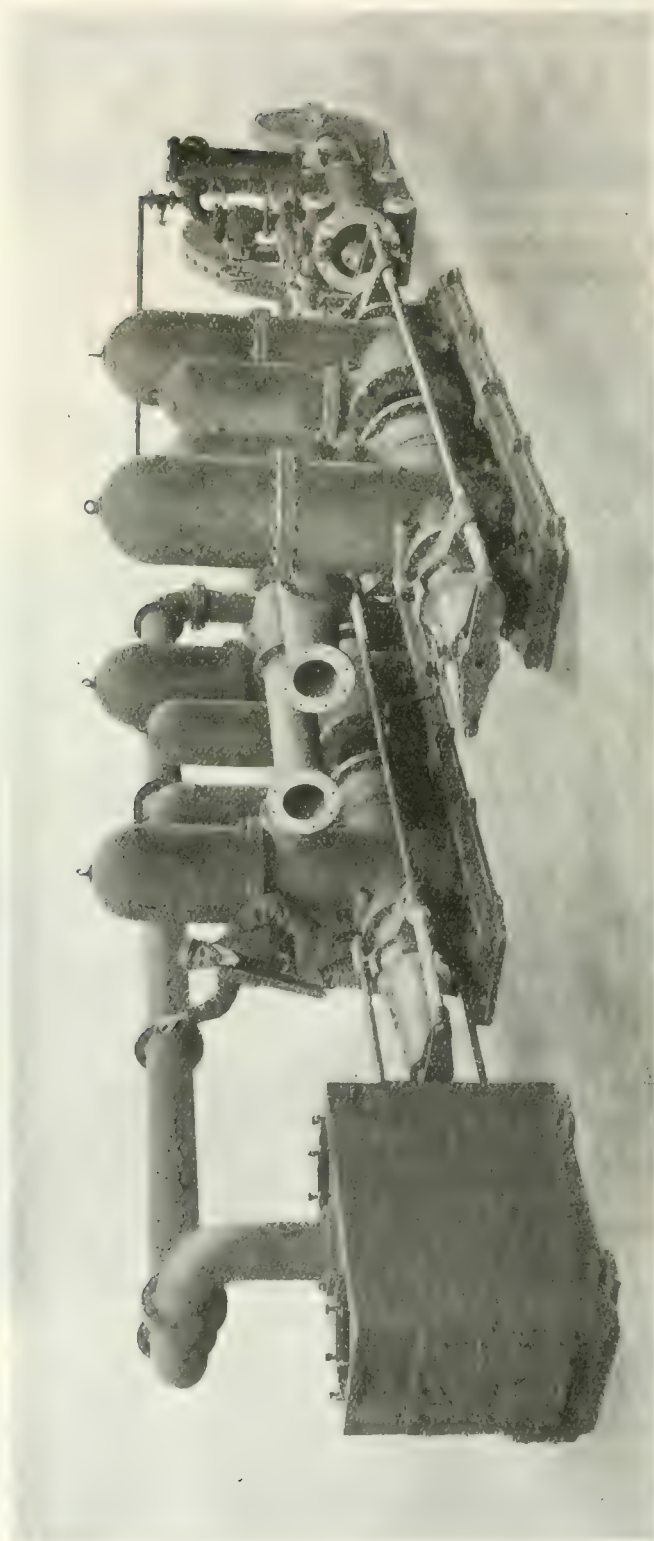
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A STEAM-DRIVEN SET OF ODDIE-BARCLAY PUMPS, CAPACITY 2,000 GALLONS PER MINUTE.

THE NEW ODDIE-BARCLAY MINE PUMP.

The above illustration shows a new high-speed pump which is known as the Oddie-Barclay and has been produced by Messrs. Andrew Barclay, Sons and Co., Ltd., of Kilmarlock after much trial. This steam driven set is capable of delivering 2,000 gallons of water per minute. There are four rams $1\frac{1}{2}$ in diameter by 2 ft 4 in stroke, coupled direct by side rods to the piston rods, of a Barclay-Corliss cross compound pumping engine. The cylinders are 18 in diameter and 33 in diameter by

2 ft. 4 in. stroke. The same Oddie-Barclay system, which consists in mechanically controlling the suction valve of the pumps, is applied to other mine pumps for belt, rope, or direct electric drive; some are differential and some ram pumps, and Messrs. Barclay, Sons and Co. have delivered, and have on order, about seven sets for heads up to 1,200 ft. They occupy very small space, and give efficiencies up to 87 per cent.

kind of exhibition where you get down to business without exhibiting anything. As regards those who *do* exhibit, it may be said that there is much to learn whether the visitor be interested in electrical, mining, or other branches of engineering, or is a mere idler, susceptible, however, to the latest domestic facilities wrought by electricity—when the current is on.

If he is in search of amusement and does not find it at Olympia he will probably get it in the return journey by the newly electrified District Railway. The promiscuous halts between stations are calculated to raise up new vocabularies and as for the automatic doors of the cars, he will find endless amusement in watching their effect upon the average passenger. A fat man may dart through and escape annihilation where a thin man may pause, vacillate and withdraw his thin and hungry visage just in time to avoid being caught with a snap. This, doubtless, has something to do with the fortune of war and the law of chances, but is it safe to assume that the dresses of ladies and the leisurely movements of the unsuspecting will always escape untrapped? Seriously we think these doors need better management. Some of the employees, too, need to learn that electrical appliances do not necessarily make a railway. Intelligent co-operation and civil deportment is necessary on the part of the staff, and some of them might with advantage study the methods of the Central London Railway.

It would be quite impossible to exaggerate the importance of a complete technical dictionary for translation purposes in the English, French, and German languages, and we shall be careful to avoid a *faux pas* in this direction, but we are glad to place on record the fact that the Technolexicon of the Society of German Engineers is making good progress, and that the preliminary work will be published about the middle of next year. At the end of 1506 printing will commence, and a period of three years

will elapse before it is finished. No one who has had anything to do with journalism—technical journalism especially—will wish to minimise the importance of having the right word in the right place. Even the accidental transposition of two letters has been known to wreck an otherwise intelligent paragraph, and we should therefore be proportionately grateful to Dr. Hubert Jansen and his 2,000 firms and collaborators who are lending their aid to the accomplishment of this great work. Up to the end of September 2,700,000 word cards had been collected, and to them will be added the hundred thousand cards that will result from the working out of the original contributions not yet taken in hand.

It is a big business and one which, from its very magnitude and pluck, should compel the aid of all who are competent to assist. If any of our readers wish to do this, a post-card will doubtless adequately serve the purpose. Dr. Jansen is the editor-in-chief, and his address is Technolexicon, Berlin (N.W. 7), Dorotheenstrasse, 49. The new dictionary was commenced in 1901 by the Society of German Engineers (Verein Deutscher Ingenieure), and at the present time there are no less than 371 societies (58 English, 38 French, and 275 German) co-operating in the work. Among British societies may be mentioned the Iron and Steel Institute, the Institution of Mechanical Engineers, the Institution of Electrical Engineers, the Junior Institution of Engineers, the Society of Chemical Industry, the Institution of Gas Engineers, the Institution of Mining Engineers, the Society of Architects, the British Optical Association, the Optical Society, the Cycle Engineers' Institute, and the South African Association for the Advancement of Science.

The blocking of the Suez Canal by a sunken vessel laden with dynamite and the drastic steps taken last week to remove that obstacle make a vivid appeal to the imagination. The

Chatham with between eight and ten tons of dynamite and blasting gelatine, caught fire in the canal and after heroic attempts to save her, during which the workers were exposed to the risk of instantaneous annihilation, she was so deluged with water that she sank, and immediately became a formidable menace to the navigation of the canal. There was no other alternative than to blow up the whole concern, and on Thursday this was done by experts, the inhabitants of Port Said in the meantime quaking in their shoes. Their fears, however, were groundless, for the work was carried out without a hitch. When the explosion occurred (says one account) a huge column

of water, sand, and debris was thrown 2,000 ft. into the air, and when it fell back it partly covered the canal banks for a distance of 300 yards. The noise of the explosion was only faintly heard. It was found subsequently that the ship had been blown to fragments, but that the east bank of the canal had been destroyed for a distance of 600 ft. The west bank, the railway, and the sweet water canal were, however, undamaged, and telegraphic communication was only interrupted for two hours. The canal dredgers and divers were soon at work clearing away the debris.

The remarkable growth of traffic through the canal is shown by the foregoing table taken from a recent return. Another table in the same return shows that the gross tonnage of British ships passing through the canal last year was no less than 12,164,591. Germany coming next with 2,736,067.

In certain quarters, we are assured by scare-mongers, that in the Japanese we have a coming menace to our commercial supremacy. Possibly it traced to its original source this idea might be found to spring from the absurdly jealous continental criticism of the new alliance, which has filled the columns of certain newspapers. "Perils," yellow and otherwise, are chiefly heard about when the world is in want of news. As regards China, at any rate, those who look with an unkindly eye upon Japanese enterprise can take comfort from the new agreement which, besides preserving peace in the Far East, is designed to effect the preservation of the common interests of all powers in China by insuring the independence and integrity of the Chinese Empire and the principle of equal opportunities for the commerce and industry of all nations in China. Doubtless much will be done to cement Japanese friendship by the visit of the British Naval Squadron which is expected at Yokohama on Monday.

YEARS.	Number of Vessels.	Tonnage.	Net Tonnage.	Mean Net Tonnage per Vessel.	Gross Tonnage.
1870 -	446	651,915	436,609	888	5,159,327
1871 -	565	1,142,200	761,467	995	8,993,733
1872 -	1,082	1,744,451	1,160,743	1,071	16,407,591
1873 -	1,171	2,085,522	1,367,768	1,166	22,897,319
1874 -	1,264	2,423,672	1,631,650	1,290	24,859,343
1875 -	1,494	2,940,708	2,009,984	1,345	28,886,302
1876 -	1,457	3,072,137	2,096,772	1,439	30,440,444
1877 -	1,663	3,418,950	2,355,448	1,416	33,771,111
1878 -	1,593	3,591,535	2,269,678	1,427	31,994,229
1879 -	1,477	3,107,442	2,263,332	1,532	29,686,061
1880 -	2,026	4,344,520	3,057,422	1,509	37,410,444
1881 -	2,007	5,794,491	4,136,780	1,517	51,274,353
1882 -	2,008	7,122,126	5,074,809	1,546	60,546,892
1883 -	3,007	8,051,307	5,777,862	1,746	66,847,812
1884 -	3,084	8,000,067	5,871,501	1,787	62,378,116
1885 -	3,624	8,965,112	6,339,753	1,748	62,207,419
1886 -	3,100	8,183,313	5,767,656	1,860	56,527,391
1887 -	3,137	8,400,043	5,903,024	1,881	57,862,371
1888 -	3,440	9,437,957	6,640,834	1,930	64,832,273
1889 -	3,426	9,605,745	6,783,187	1,951	66,677,770
1890 -	3,389	9,749,129	6,800,991	2,033	66,981,000
1891 -	4,207	12,217,986	8,698,777	2,067	87,422,104
1892 -	3,559	10,866,401	7,712,029	2,167	74,170,111
1893 -	3,341	10,754,798	7,659,068	2,292	70,667,361
1894 -	3,005	11,293,954	8,009,175	2,668	73,776,927
1895 -	3,434	11,433,637	8,448,383	2,454	78,103,717
1896 -	3,430	11,400,000	8,560,283	2,511	79,569,924
1897 -	2,996	11,123,403	7,890,000	2,645	72,830,543
1898 -	2,700	11,000,000	7,800,000	2,889	80,294,500
1899 -	3,007	13,815,391	9,895,630	3,243	91,318,772
1900 -	3,441	13,699,287	9,738,152	2,830	90,623,608
1901 -	3,000	13,000,000	9,000,000	2,250	100,386,397
1902 -	3,000	13,000,000	9,000,000	3,034	103,720,020
1903 -	3,761	16,615,309	11,907,283	3,160	103,620,268
1904 -	3,000	18,661,092	13,401,835	3,163	115,818,479

Note.—The above figures represent the net tonnage of vessels passing through the canal, as well as the gross tonnage.

TRAFFIC ON THE SUEZ CANAL.

PAGE'S WEEKLY

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NEWS ITEMS.

The number of people who took part in the great lock-out in the electrical industry at Berlin, was on Wednesday estimated at 40,000.

The Council of the Royal Agricultural Society has referred back to the Special Committee the recommendation for the disposal of Park Royal.

The Majesty King Edward will receive the members of the Paris Municipality, who are to be the guests of the London County Council, this month.

The meetings of the fifteenth session of the Institution of Mining and Metallurgy have been arranged as follows: October 19th, November 16th, and December 21st, 1905; January 24th, 1906; and May 17th, 1906 (annual meeting), April 19th and May 17th, 1906.

From the annual report issued by the Home Office it appears that last year 877,057 persons were employed in and about mines in the United Kingdom, and 97,577 in quarries. During the year there were 1,158 fatal accidents in mines and quarries, causing the loss of

The Miners' Federation of Great Britain opened a conference on Tuesday at Blackpool, and passed a resolution to press forward the Trade Disputes Bill, in order to place the funds of trade unions in the position in which they were believed to be before the decision of the House of Lords in the Taff Vale case.

CONTENTS.

[illegible]

Gold Production in Madagascar.

The following statements of the development of the gold industry of Madagascar are taken from the report of the Director of Mines, published in the Bulletin économique de Madagascar: The export of gold during 1904 amounted to 1,910 kilogrammes as compared with 1,910 kilogrammes in 1903, an increase of over 28 per cent. The production last year was 2,552 kilogrammes, valued at 7,656,000 francs.

The number of prospectors' permits issued was 1,903, against 553 in 1903. This development is considered to be due to a large extent to the uneasiness in general business in 1904. It seems, therefore, likely to be transitory and not to be counted on to show a proportionate advance in succeeding years. On the other hand, no considerable relapse is likely to take place. Numerous applications continue to be made for permission to carry out researches in the Tsinjoarivo district, where it frequently happens that old claims only just abandoned are taken again by new prospectors.

The success obtained in the eastern part of the island by certain prospectors, in the Provinces of Mananjary, Betsimisaraka in the south, the districts of Beforana, Fetraomby, and the Province of Fenerive have directed efforts to that side. The west coast has not been exploited to the same extent, although probably rich in the precious mineral also. Certain points have been worked with hopeful results, viz.: Ankavandoa, Tsimivolovolo, Betsiriry, and Imaina, and a more definite attempt at exploiting these regions may come with the increasing prospecting in the island.

The portrait of Professor Oliver Arnold, reproduced in our last issue, was taken by Messrs. Elliott and Fry.

The daily press states that all the Powers have now received the general invitation of the Tsar to take part in a second Hague Conference (!)

Marconi's Wireless Telegraph Company, Ltd., have received the highest award for their exhibit of wireless telegraph apparatus at the Liège Exhibition.

Mr. H. G. L. Kendrick, M.Inst.M.M., has sailed for Mexico and Mr. W. L. A. Thomas, Assoc.R.S.M., M.Inst.M.M., for Canada on mining business for Messrs. Pearse, Kingston and Browne.

Mr. James E. Sayers, of 157, West George Street, Glasgow, advises us that he has assumed Mr. James Caldwell, formerly his assistant, as partner in business, the new firm practising as consulting engineers and electricians at the above address, under the name of James E. Sayers and Caldwell.

Royal School of Mines.

The accompanying list of names of the students who have been issued —

Mining.—Honours, Henry Briggs, 1st Class: Thomas Herbert Bayldon,* Donald Fraser Campbell, Matthew Arnold Francis, George Haworth, Robert Clarke Munro. 2nd Class: George Binton, Alexander Ostrand Brown,* William Frederick Collins,* Nanabhai Dayabhai Daru, Percival St. John Dixon, Gordon Duff, Bennett Gilroy Cranford Gardiner,* Walter Stanley Gifford,* Guy Francis Harrison,* Raymond Langley Hassall, John Edmund Haworth, Geoffrey Finstone Heath, Archibald Macdonald Hogarth, Percy Humphrey Ironside, Stanley Ramplen Jones,* Carlos Latorre, John MacLennan, Owen Fortrie Parker, Alec Alexander Thomson.

Metallurgy: 1st Class: Herbert Edgar Arrowsmith, Reginald William Godfrey Corfield, Ernest Hibbert, Francis Gordon Sherwood. 2nd Class: William Frederick Collins, Nanabhai Dayabhai Daru, Arthur Edwin Pratt.

SCHOLARSHIPS AND PRIZES 1905 (R.S.M. AND R.C.S.).

The Institution of Mining and Metallurgy Scholarships:

Mining.—Donald Fraser Campbell and Matthew Arnold Francis (divided).

Metallurgy.—Herbert Edgar Arrowsmith.

Royal Scholarships.—

First year.—Albert Eagle, Harry Moore, Stewart Scott Spears, Ralph Sydney Read.

Second year.—Frederick George Blyther, Arthur Albert Rowe.

Marshall Scholarship.—

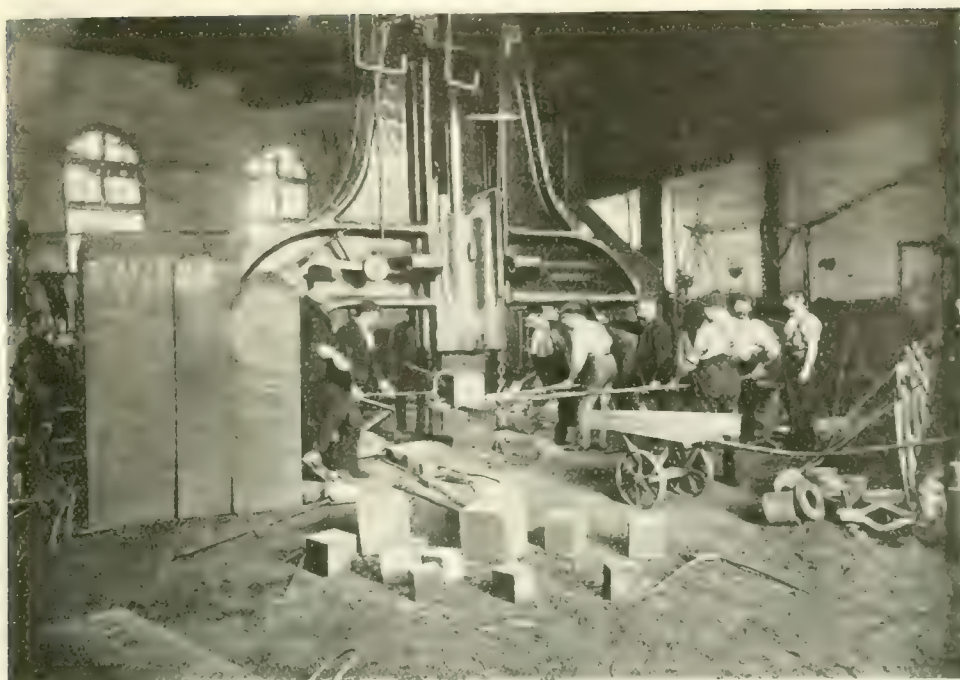
Arthur Samuel Horne.

Other Medals and Prizes.—

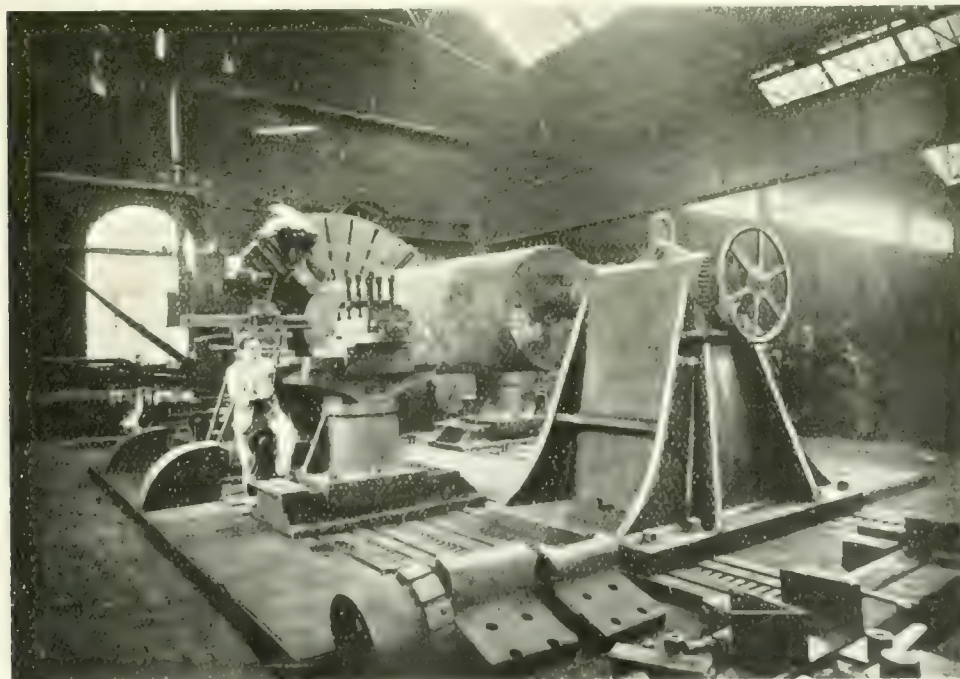
"Edward Forbes," medal and prize of books for biology, Arthur Samuel Horne. "Murchison" medal and prize of books for geology, Hugh Burton Corbin. "Tyndall" prize of books for physics, Part I., Albert Eagle. "De La Beche" medal for mining, Donald Fraser Campbell, Matthew Arnold Francis. "Bessemer" medal and prize of books for metallurgy, Reginald William Godfrey Corfield. "Frank Hatton" prize of books for chemistry, Donald Francis Blyther. "Edward Matthey" prize, Donald Myer Levy. "Warrington Smyth" medal and prize, not awarded. "Huxley" medal, Miss L. Digby.

Books given by the Board of Education.—Mechanics, Herbert Moss. Practical Chemistry, Harold Martin Walkden. Mining, Donald Fraser Campbell, Matthew Arnold Francis. Mathematics, Archibald Read Richardson. Physics, William Francis Gray Swann.

* Qualified, but no diploma to be issued until the required number of shifts underground to be completed.



FORGING BLOCKS FOR PRESSING AND STAMPING DIES AT THE WORKS OF MESSRS. THOMAS FIRTH AND SONS, LTD., SHEFFIELD. (See page 779.)



LARGE INGOT TURNING LATHE AT THE NORFOLK WORKS OF MESSRS. THOMAS FIRTH AND SONS, LTD. WITH 12 FT. FACE PLATE.

New Steam Car.

The first of a new type of steam car, built by the Glasgow Railway Engineering Company for the Alexandria Dock and Railway Company. The car is 64 ft. 11 in. in length, and weighs, when in working order, 35 tons. The working parts are on much the same lines as those of the first car supplied, steam being generated in a loco. type of boiler, fitted with Drummond water tubes, and designed for a working pressure of 160 lb. per square inch. The cylinders, 9 in. in diameter with a 14 in. stroke, are fixed on the outside of the boiler flange plate, and fitted with Walschaert's valve gear.

Effect of Recent Railway Developments on Employees.

The report presented at the annual meeting of the Amalgamated Society of Railway Servants spoke of the society's continued influence for good in all directions. The membership had risen from 52,355 to 53,407 in the 616 branches. The total receipts for the year were £69,692, an increase of £3,735 over last year. The president, Mr. J. H. Thomas, discussing the effect of recent railway developments upon employees, adverted to the question of the larger type of engine. He found from the railway returns that in 1904 the railway companies carried 34,000,000 more tons of merchandise than in 1903, and received

£1,000,000 more revenue for the same period. This was accomplished with a saving of 17,900,000 train miles, and a decreased expenditure in wages in actual running of no less a sum than £7,000,000. In other words, if this traffic was handled in 1904 in the same way as in 1901, 32,000,000 more train miles would have been run and 1,777 engines used in its transmission. If they compared these figures with the year 1899, when this policy was inaugurated, the effects upon enginemmen and firemen are apparent. The change meant not only that fewer locomotive men by thousands were required, but hundreds of men hitherto on the right hand side of the engine were now firing, and firemen were cleaning. The prospects of promotion were, indeed, gloomy, and if these changes had justified their existence they must surely ask themselves what would be the ultimate result, and when would the limit be reached?

Remuneration of Engineers on Steam Vessels.

The following figures from a recent return show the predominant rates of salary paid to engineers upon steam vessels engaged in the foreign trade, and registered in the British Islands. The rates are monthly, and are in addition to provisions, except when otherwise stated. Exceptional rates, such as those paid to officers on cable ships, or to guarantee engineers, are not included. The amounts are stated in shillings.

		1880.	1890.	1895.	1897.	1898.	1899.	1900.	1901.	1902.	1903.	1904.
First Engineers	Under 500 tons (weekly, without provisions)	62	65	66	66	64	63	64	60	69	70	70
	Of 500 and under 1,000 tons	311	297	270	280	280	280	280	275	275	270	275
	Of 1,000 and under 1,500 tons	326	315	300	300	300	310	300	310	310	295	305
	Of 1,500 and under 2,000 tons	330	336	320	320	320	325	330	335	330	325	335
	Of 2,000 tons and upwards	372	353	360	380	380	370	365	355	350	355	355
Second Engineers	Under 500 tons (weekly, without provisions)	43	43	44	44	45	47	43	45	47	49	47
	Of 500 and under 1,000 tons	216	205	195	200	200	200	200	220	200	200	205
	Of 1,000 and under 1,500 tons	234	223	220	210	210	220	215	220	215	210	215
	Of 1,500 and under 2,000 tons	241	223	230	230	230	240	230	235	235	235	235
	Of 2,000 tons and upwards	280	255	250	270	270	265	255	265	255	245	250
Third Engineers	Under 500 tons (weekly, without provisions)	-	36	-	-	30	-	37	45	44	42	-
	Of 500 and under 1,000 tons	156	144	130	140	135	135	135	145	145	135	135
	Of 1,000 and under 1,500 tons	163	157	155	155	155	150	150	155	155	145	145
	Of 1,500 and under 2,000 tons	197	171	160	160	160	165	160	165	165	165	165
	Of 2,000 tons and upwards	224	187	190	190	190	205	195	195	190	190	195

SALARIES PAID TO ENGINEERS UPON STEAM VESSELS ENGAGED IN THE FOREIGN TRADE.

MACHINE DRILLS FOR HARD ROCK.

By ARTHUR H. SMITH.

THE subject of machine rock drilling for boring shot holes is one of leading importance to the mining engineer, and to the civil engineer the subject is of equal importance. Many engineering schemes, necessitating the removal of vast quantities of hard rock, owe their successful completion to the assistance of the machine drill. The Mont Cenis and St. Gothard tunnels, respectively $7\frac{1}{2}$ and $9\frac{1}{4}$ miles long, the 34-mile Croton Aqueduct tunnel, the Chicago drainage canal, which involved the removal of 1,400,000 cubic yards of solid rock, and now, recently, the 12-mile Simplon tunnel, are notable examples in point.

With the exception of the Simplon tunnel, and a few comparatively isolated instances, the whole of the world's machine drilling in hard rock, down to the present day, has practically been accomplished by means of striking or reciprocating machines, in which the drill bit is an extension of the piston rod, and is actuated by steam or compressed air. Rotary machines, as a class, are unsuitable for fastshot hole boring in hard rock, and the author proposes to include only the one machine of that type which has proved itself of value for this particular class of work, namely, the Brown drill.

HAND-POWER ROCK DRILLS.

In the Jackson Hand-Power Drill the blow is given by the recoil of a compressed spring. The interior mechanism consists of a ram with collars, cam axle and cams and the power spring, together with a ratchet bar and ratchet controlled by pawls and springs to effect rotation. It is operated by means of a hand crank, momentum being imparted by a couple of flywheels. The drill delivers three-and-a-quarter strokes for each revolution of the crank, or from 175 to 200 per minute at ordinary speed, each blow being about 50 lb., according to the strength of the spring. The length of the stroke and the tension of the spring may be readily varied. The machine weighs about 140 lb.

Though perhaps hardly within the limits of the present paper, the drillbit is of sufficient interest and novelty to warrant inclusion. The drillbit is not a machine drill, but a bit holder and turner, its object being to reduce the number of men employed on double-handed drilling. The features of the arrangement are the cylindrical body through which the drill steel is passed, and a rotating device to which is attached a four-jaw grip by which the drill steel

is held during lift and rotation. A foot lever works in conjunction with the rotating device and has an automatic escapement whereby the cutting edge of the borer is returned with pressure against the bottom of the hole. Thus the drill-man beats the borer held up in position by the machine, then depresses the foot pedal which causes the bit to be automatically lifted, rotated and replaced against the cutting face. The weight complete is about 70 lb.

STEAM AND AIR ACTUATED ROCK DRILLS.

The power driven hand rock drill type is an evolution of the pneumatic caulking or chipping hammer in which the piston reciprocates rapidly and strikes a great number of blows per minute on the end of a tool inserted in the end of the cylinder. It is operated by compressed air, and the light weight of the smaller sizes permits the machine to be easily held up by hand. The various sizes made range from $1\frac{1}{16}$ in. cylinder by 4 in. stroke, to $2\frac{1}{2}$ in. by $2\frac{1}{2}$ in., consuming approximately from 20 to 45 cubic feet of air per minute, at from 80 to 90 lb. pressure. The rotation of the smaller sizes is effected by hand, whilst the larger machines have automatic twist gear. The number of

TABLE OF DRILLS.

Size of Drill	Stroke	Feed	Length of Hole per Revolution	Temperature of Hole	Weight of Machine	Consumption of Air at 90 lb. Pressure	Rev. per Min.	Remarks
1	16	12	1	10 to 12	88	35	10	Case of work best suited for this machine.
2	14	12	1	10 to 12	88	35	10	Plus and feather small shales, limestones, light work.
3	5	20	6	14 to 2	128	47	8	Drill small tunnels into narrow veins.
4	10	27	12	14 to 3	130	80	8	Mining tunnels, shafts.
5	7	27	10	14 to 3	238	100	9	Standard size for general sized mining work.
6	7	28	10	14 to 3	280	100	10	Large open quarries, big tunnels, and road way drifts.
7	7	30	10 to 12	14 to 4	300	100	12	Special quarrying drill for deep holes with large diameter foot cylinder for lifting the bit in deep hole work.
8	7	30	10 to 12	14 to 4	300	100	12	Heavy tunnelling, heavy road way work, etc.
9	8	30	28	20 to 1	300	100	15	Heavy quarry work, heavy road way, etc.
10	8	30	30 to 12	20 to 1	300	100	15	Same as No. 9.

blows per minute range from 800 to over 2,000. The machines weigh from 12 $\frac{1}{2}$ to 45 lb. They are adapted for light plug or popping holes of about $\frac{1}{8}$ in. diameter to a depth of 3 ft. Tabulated information is given on page 753.

The standard steam or air actuated rock drills may be broadly divided in two classes according to valve gear, viz.: (a) the tappet type, and (b) the fluid moved valve type. There is a third arrangement, which may be termed the valveless type, in which the moving piston acts as its own valve.

Some machines will do fair work in soft rock at 45 lb., but in most mines 65 to 90 lb. are chiefly used, the tendency being to increase these pressures in hard ground.

The author knows an instance of air being supplied to rock drills at 160 lb., but such machines are specially reinforced to stand the strain, and breakages are frequent.

A quarter of a century's experience has taught the leading manufacturers of rock drills the best materials to stand the strain of the respective parts of the machine. Thus the cylinder shell and valve chest are usually of special cast-iron, the cradle of cast-steel, the ratchet box and cover of specially toughened steel, the piston rod of solid open hearth steel, the valve of case-hardened iron or cast-steel, the tappet, the ratchet and pack and the twist bar

of tool steel, the twist nut of bronze, the bolts, studs, feed screw, handle and nut, and tool holder and fittings all of best mild steel.

Various forms of tool holders are made, but the U-bolt and the taper chuck are chiefly used. With the former the bit shank requires no swaging, and is secured in the holder by a couple of nuts, whilst with the latter the drill shank has to be tapered up, and is self-tightening in the chuck, loosening the bit being effected by driving in a cotter behind the shank tail.

Automatic feed is sometimes employed in the largest size machines for down holes.

HOLMAN DRILLS.

The Holman air valve drill is shown in fig. 1.

The Holman tappet is illustrated in fig. 2, which clearly shows its construction, and the action requires but little explanation. A large diameter is given to the front cylinder for lifting the bit, and in this way holes are commonly bored to a depth of from 10 to 40 ft. For working tappet drills by steam a blow-through cock is generally fitted to the machine to get rid of excessive moisture in the pipe line.

A variation of the tappet valve gear for rock drills has been erected in the Rix drill by the disposition of a pair of Corliss type valves at each end of the cylinder, operated by means of a segmental rocker actuated by a necking in the piston. By this arrangement the clearance space between the valve port and the cylinder is reduced to a minimum, and a large port opening is obtained for inlet and exhaust. The stroke of this drill is very rapid; at 80 lb. pressure the 2 $\frac{1}{2}$ in. cylinder machine strikes 850 blows, and the 3 $\frac{1}{2}$ in. machine 650 blows per minute.

Compounding is arranged in several rock drills, the best known being the Schram and Hirnant.

The Leyner Hammer Blow Rock Drill, illustrated in fig. 3, is a departure from the standard type of air drill, inasmuch as the borer bit is entirely disconnected from the piston, the steel being struck by the ram at each stroke.

Provision for a water jet is made a needle valve

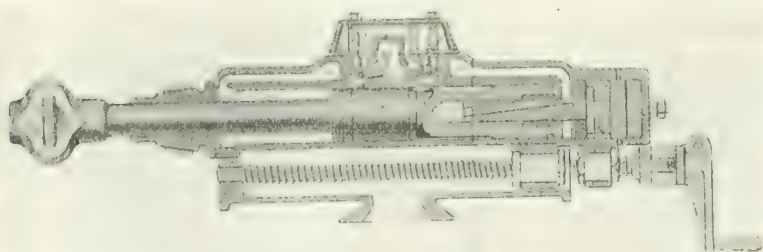


FIG. 1. HOLMAN AIR VALVE DRILL.

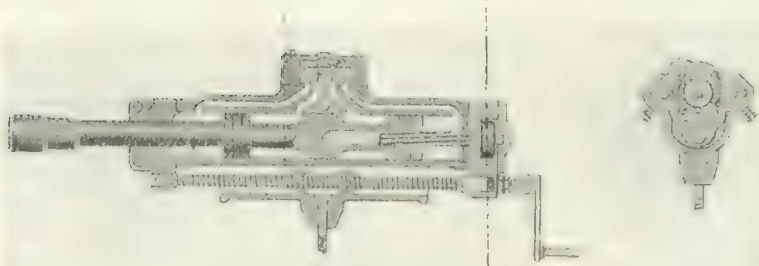


FIG. 2. HOLMAN TAPPET DRILL, WITH CROSS SECTION OF SAME.

at the ratchet end of the machine admitting water to a $\frac{1}{4}$ in. steel tube which conveys it without contact with the working parts through the machine into the shank of the hollow borer. The parts are welded into the complete borer, which is hollow throughout its length, the hole being $\frac{5}{16}$ in. to $\frac{3}{8}$ in. diameter, thus allowing water to be carried and discharged at the cutting point. The 3 in. cylinder drill has a stroke of 3 in. and 24 in. feed. It is only adapted for use by compressed air, weighs 155 lb. unmounted, and consumes about 75 cubic feet of free air per minute at 80 lb. The machine can be fixed to any standard type of mounting. An 18-gallon tank is provided with the drill, this quantity of water being sufficient to supply a jet for a shift in ordinary formations.

ELECTRIC ROCK DRILLS.

The Gardner drill is a mechanical drill of the reciprocating type, motion being given to it by a live shaft run at high speed by an electric motor, the actual blow being due to the recoil of springs. There is little departure from standard air drill construction except where necessitated by requirements due to the employment of a different source of power.

The driving axle passes through the crosshead of the drill where a slot is so arranged that one-fourth of the forward movement of the axle crank gives the full striking blow. The piston-shaped guide is forward of the crosshead. One of the two buffer springs which provide the recoiling power is placed inside the front end of the crosshead, whilst the other fits closely against its outer front end. Running speed is controlled by a small starter at the rear end of the machine. The current required for driving is 110 volts, which is harmless to the operator. These drills are made in three sizes, the largest, which has a 3 in. stroke, strikes

about 500 blows per minute, and will cut holes up to 9 ft. deep, starting with a 3 in. bit. It weighs 315 lb. unmounted and requires a 2-h.p. motor which weighs 225 lb.

The Solenoid Electric Rock Drill derives its reciprocating action by the sucking power of solenoids. The principle is that of two or more solenoid coils within which works an iron core or piston, the reciprocation of which is obtained by passing an electric current first through one solenoid and then through the other the iron core being thus attracted alternately in each direction. A special electric generator is required to produce the pulsating current necessary for the operation of the drill. The weight of a solenoid rock drill to bore ordinary 16 ft. holes is 445 lb. unmounted, length of feed 24 in., strokes per minute about 380, and power required to drive the machine, as applied to the generator pulley, 9½ h.p., pressure 140 volts.

HYDRAULIC ROCK DRILLS.

The Brandt Hydraulic Rock Drill is the invention of the late Mr. Brandt, who was superintendent mechanical engineer on the St. Gothard boring contract. It may be described as a large auger pushed forward with a pressure of about 10 tons on the drill point and slowly rotated, the rock being crushed rather than pulverised. The machine consists essentially of two parts—a motor for rotating the drill and a pressure ram for forcing the borer bit into the rock.

The borer rod is of hollow forged steel, and to the end of this is screwed the cutting bit. This bit is made of the same material as the extension rods, and is provided with either two, or three, sharp teeth according to the rock to be drilled. The teeth are cut by a milling machine, sharpened up by hammer, and

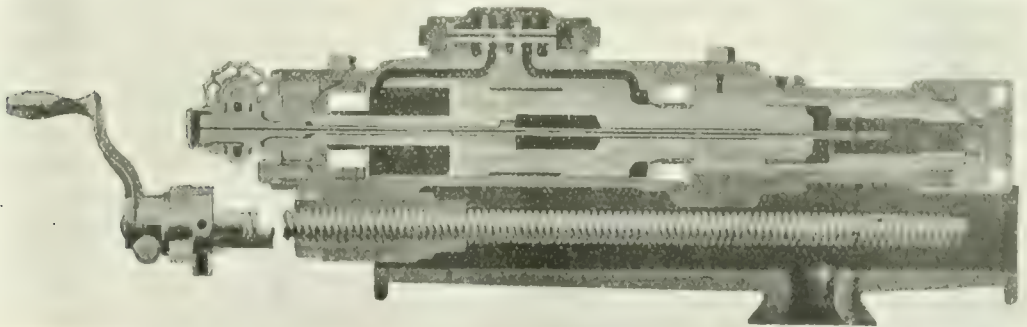


FIG. 4. THE LYSTER HAMMER BLOW ROCK DRILL

tempered. Both the extension rod and bit are hollow throughout their entire length, exhaust water being passed through them in course of drilling, thus keeping the bit cool, clearing away any chips at the point and incidentally killing all dust. When the ram has reached the end of its 26 in. stroke, or when the bit is blunted, the borer is withdrawn from the hole by reversing the direction of the ram pressure, the toothed bit unscrewed, and a fresh bit or further extension rod added as required. Like any other drill, the bits must follow in diminishing diameter as hole deepens. The work of changing bits or adding rods only occupies a minute or so.

The machine is mounted on a horizontal hydraulic rack bar, 12 in. in diameter, which is carried on the end of a pivoted lever and mounted on a four-wheeled trolley. Thus the drill can be run into position, the rack bar set to a convenient height across the face, and jammed by hydraulic pressure between the walls of the heading by the opening of a valve after connection has been made with the pressure pipe.

The machine is made to work under pressure of 900 to 1,400 lb. to the square inch. Rotating at about eight revolutions per minute, a hole 3 ft. 3 in. in length by $2\frac{3}{4}$ in. diameter is usually drilled in from twelve to twenty-five minutes. On a cross-section of 59 square feet, a face of ten or twelve holes of about 5 ft. deep is holed by three machines in from two or three hours in antigorite gneiss. Each drill uses a maximum of two litres or nearly half a gallon of pressure water per second. The weight of the drill described is 880 lb., but a smaller type, with about 12 in. stroke, is also made, its weight being about 650 lb. Only the heavier drills were employed on the Simplon boring, where, to keep nine machines at work, fifteen were kept on hand.

INTERNAL COMBUSTION MOTOR DRILLS.

The "Bull Dog" Drill is a novel application of the internal combustion motor to the work of boring, the blow being given by a hammer ram actuated by the explosion of gasoline vapour within the cylinder of the machine, a small electric outfit furnishing the spark ignition. It is in effect a reciprocating drill of the hammer blow class, the chuck holding the bit being struck at each stroke by the ram, rotation being effected on the rebound of the steel by ratchet and pawl gear. The machine is similar in appearance to the standard air drill, but with the addition of a pair of flywheels and connecting rods.

The power outfit consists of six dry cells or batteries, a high tension spark coil, and a copper tank containing a day's supply of gasoline. This outfit is housed in

three substantial cases combined in one package, upon which is located the automatic carburettor or mixing valve which converts the power fluid into gas, producing the proper mixture for the operation of the machine. Ports opening into the cylinder admit the mixture and deliver up the gases after explosion, these ports being automatically uncovered and covered by the passage of the piston over them. The motor is air-cooled.

No difficulty arises from the exhaust gases in open air working, but underground the air would be greatly vitiated by the fumes. This is obviated by means of an exhaust pipe line to surface, the attachment from the drill to this being made by a length of fireproof flexible hose. The machine can be fixed on any standard air drill mounting. The power outfit is mounted on a stand and placed conveniently close to the drill. The weight of the drill unmounted is 325 lb., that of the power plant, 75 lb., and the consumption of gasoline per eight-hour shift is three gallons. The machine—which is only made in one size, 4 in. cylinder by 4 in. ram—strikes about 1,500 blows per minute. There is no available data as to its performance, in practical working the application being a very recent one.

MOUNTINGS AND FITTINGS.

The cylinder of a rock drill slides in a guide or cradle which in turn is mounted on a stretcher bar, tunnel column or tripod, etc., according to the work to be done. The actual attachment consists of a powerful jaw chuck or cone clamp which holds the bottom of the cradle and is in turn saddled round the bar or column and secured to it by a cap and bolts. The adjustments of the drill and saddle are independent of each other, and the drill can revolve on its seating for setting in any direction.

This fact is taken advantage of in coal mines and certain stone quarries, where a lever handle is sometimes attached to the machine for conveniently imparting a swinging action to it, the clamp nut of the mounting being given just sufficient tension to hold the machine firmly without impeding the lateral movement. Thus, by gradually swinging the machine across the face during work, the cutting bit strikes each blow in close proximity to the previous one, the outcome being a straight cut or nick right across the face. Generally each cut from one fixing is from 10 to 12 ft. in length, by from 4 ft. to 6 ft. deep, and from $2\frac{1}{2}$ in. to 3 in. across according to the size of the cutting bits employed. Some makers employ a worm gearing operated by handle to produce this swinging movement.

(To be continued.)

Read before the Society of Engineers.

THE SHEFFIELD MEETING OF THE IRON AND STEEL INSTITUTE.

SEGREGATION IN STEEL INGOTS.

By B. Talbot (Middlesbrough).

(Continued from page 725.)

To show the effect of segregation when the ingot is worked down into billets, and to show the influence of aluminium in lessening the effect of segregation when the steel is rolled into billets, the following test was made: Two ingots from Heat No. D, 2086, of which analyses of the ingot are given in Table C were rolled into blooms. The ingots were 18 by 22 square, of acid open-hearth steel. The weight of each ingot being 6,000 lb., and the analyses of the ladle test of the heat being C, 38; S, 0.61; P, 0.52; Mn 52 per cent. Table H shows the results obtained. To the ingot marked A no aluminium was added, whilst to the ingot marked B $\frac{3}{4}$ lb. of aluminium was added. As the effect of the segregation is almost entirely confined to the top third of the ingot, only this portion was analysed. Drillings were taken with a $\frac{3}{4}$ -in. drill at the centre of the billet and also at $\frac{3}{4}$ in. from the side.

Although the results in Table H show that the influence of the aluminium did distinctly lessen the effects of segregation, as shown in the billet, still segregation could be very distinctly traced. Tests were also made in the same manner on billets rolled from steel made in the basic furnace, and in this case the effect of segregation seems considerably localised, and as will be seen from Table I, it appears to a marked extent only in one spot; that is, in the centre of the section taken between the second and third billet. The following are the

analyses of the steel. The ingot was 20 in. by 24 in. by 65 in., and was taken from Heat No. H, 187. Ingot was top and bottom analyses, and analyses were added to it in casting. After casting ingot was allowed to cool in its original position.

After cooling the ingot was reheated and bloomed down to 6 in. by 6 $\frac{1}{2}$ in. After rolling to this size the ingot was cut up into small billets as follows: First, the regular crop was cut off, then a small piece 6 in.

long, then a billet 4 ft. 6 in. long, then another small piece 6 in. long, then another billet 4 ft. 6 in. long.

TABLE H.—Ingot A. No Aluminium.

No.	Centre.			Side.		
	Carbon.	Sulphur.	Phosphorus.	Carbon.	Sulphur.	Phosphorus.
1	0.28	0.037	0.029	0.29	0.042	0.036
2	0.60	0.143	0.119	0.36	0.092	0.049
3	0.54	0.125	0.094	0.31	0.053	0.038
4	0.37	0.076	0.056	0.34	0.063	0.054

Ingot B. Aluminium.

No.	Carbon.	Sulphur.	Phosphorus.	Carbon.	Sulphur.	Phosphorus.
1	0.34	0.074	0.050	0.39	0.064	0.031
2	0.53	0.120	0.083	0.38	0.066	0.032
3	0.42	0.083	0.062	0.40	0.067	0.033
4	0.40	0.072	0.058	0.39	0.068	0.034

	No. 1.	No. 2.	No. 3.	No. 4.
Crop.				
Bottom				

TABLE I.

No.	Centre.				Side.			
	Carbon.	Sulphur.	Phos.	Mn.	Carbon.	Sulphur.	Phos.	Mn.
1	0.54	0.053	0.038	0.61	0.53	0.054	0.037	0.60
2	0.58	0.078	0.036	0.63	0.49	0.051	0.034	0.60
3	0.71	0.135	0.065	0.57	0.54	0.056	0.035	0.64
4	0.55	0.058	0.036	0.64	0.54	0.038	0.034	0.63
5	0.66	0.064	0.036	0.64	0.52	0.062	0.036	0.63
6	0.52	0.064	0.034	0.60	0.51	0.062	0.036	0.61
7	0.61	0.068	0.041	0.59	0.51	0.062	0.038	0.60
8	0.53	0.057	0.035	0.62	0.52	0.059	0.039	0.62
9	0.51	0.062	0.039	0.62	0.51	0.064	0.040	0.61
10	0.50	0.069	0.039	0.61	0.53	0.066	0.037	0.63
11	0.52	0.074	0.035	0.61	0.50	0.056	0.036	0.63
12	0.50	0.059	0.036	0.61	0.50	0.044	0.032	0.62
Ladle test	0.45	0.0671	0.0391	0.60	0.518	0.0578	0.0390	0.616
13	0.50	0.0620	0.0370	0.618				
14	0.50	0.062	0.040	0.60				

and so on until the whole ingot was cut up and twelve small pieces each 6 in. long had been cut from the same. From these small pieces drillings were taken from the centres and sides and analysed, with the results shown.

Another ingot from the same heat, and to which the same amount of aluminium was added, was inverted after casting and allowed to cool in this position. After reheating the ingot was bloomed down to 6 in. by 6½ in., and 6-in. pieces and 4 ft. 6 in. billets cut off as before. In this case, of course, segregation was to be expected in the billets from the lower third of the ingot. Here, again, we find the excessive segregation is strictly localised, being found only in centre of No. 11. (See Table K.)

So far as the author is aware, Pourcel was the first to point out that the addition of aluminium gives homogeneity to the steel. The analyses given in the table certainly tend to confirm this view. The reason why this should be so seems somewhat obscure, and the author does not wish to put forward any view on the subject by way of explanation, but the following considerations may serve to throw some light on the question.

His experience on the addition of aluminium in the ingot mould during casting has always been that the aluminium appears to make the metal set quicker. This, he is aware, is against the view usually held by metallurgists. Thus, in Mr. Harbord's recently published book on steel, it is stated: "The addition of very small amounts of metallic aluminium to such metal" (*i.e.*, metal containing dissolved oxides) "is found to cause a marked increase in the fluidity of the molten metal, to stop the evolution of gas, and to allow of the production of sound ingots without blow-holes." Mr. Harbord, however, does not seem entirely satisfied with this view, as on the same page, in referring to Mr. Hadfield's classic work on aluminium steel, he tells us that, according to that investigator, it is doubtful whether aluminium increases the fluidity of properly made steel. This latter view falls in with the facts observed by the author, under whose directions aluminium has been added regularly to many thousands of casts.

TABLE K.

No.	Centre.				Side			
	Carbon.	Sulphur	Phos.	Mn.	Carbon	Sulphur	Phos.	Mn.
1	0.50	0.053	0.037	0.63	0.50	0.080	0.048	0.62
2	0.49	0.057	0.037	0.62	0.51	0.068	0.035	0.63
3	0.54	0.055	0.032	0.61	0.62	0.046	0.030	0.53
4	0.52	0.051	0.029	0.60	0.50	0.050	0.035	0.59
5	0.53	0.057	0.036	0.63	0.53	0.062	0.031	0.63
6	0.55	0.056	0.039	0.60	0.55	0.053	0.039	0.61
7	0.53	0.061	0.043	0.65	0.53	0.050	0.039	0.62
8	0.56	0.063	0.039	0.62	0.53	0.054	0.031	0.74
9	0.63	0.097	0.061	0.62	0.53	0.052	0.034	0.64
10	0.62	0.059	0.041	0.63	0.51	0.065	0.037	0.61
11	0.61	0.110	0.064	0.65	0.53	0.057	0.039	0.64
12	0.54	0.062	0.037	0.65	0.53	0.054	0.038	0.63
Average	0.543	0.0642	0.0404	0.626	0.531	0.0560	0.0363	0.624
Top average	0.537	0.0601	0.0383	0.626				
Bottom	0.59	0.062	0.040	0.62				

Not only does the addition of a little aluminium to the metal as it is run into the ingot have a marked effect in setting the surface, but it also, in the author's experience, tends, when added above a certain quantity, to form cavities in the upper part of the ingot, so that the amount added has to be strictly regulated. The setting effect on the top of the ingot is so marked that at the works with which the author was connected, after it had become the custom to add aluminium regularly, the ingots were never sanded over or stoppered down, as no such treatment was necessary, either with acid or basic open-hearth steel. With mild steel also it was found that the moulds could be stripped sooner when aluminium had been added.

It was also observed that when the same quantity of aluminium—viz., some 3 oz. to 4 oz. per ton of steel—was added to the metal as it ran into the ladle, its effect was not so pronounced as when added in the ingot mould as the ingot was being teemed.

There appears, therefore, to be somewhat of a contradiction in the facts observed, some authorities telling us that aluminium in small quantities increases the fluidity of the metal; others, with whom the author joins, contending that the reverse is the case. Theoretically, one would undoubtedly expect some increase in temperature, owing to the reaction between the dissolved oxides in the metal and the aluminium, an action akin to the well-known thermite process.

If an increased temperature is obtained, with the consequent increased fluidity, this would cause the steel to take longer to solidify, and would consequently tend to increase the segregation, provided that the aluminium has no special action of its own on the metal, whereas the numerous analyses made by the author prove that there is a considerable diminution in the amount of segregation. As the metal appears to set quicker, and as, consequently, segregation would be expected to be less, due to this quicker setting, the analyses seem to agree with this view. The author's usual practice was to add about 3 oz. to 4 oz. of aluminium per ton of steel in the ingot, but this was never added until the ingot mould was approximately two-thirds full. Assuming the aluminium to be all concentrated in this top third of the ingot, it would then only be at the rate of about 12 oz. per ton, or about 0.033 per cent. aluminium.

In the author's opinion it would be well worth while for other investigators, interested in the manufacture of higher carbon steel, such as for rail, tyre, and similar purposes, to follow up these results, with a view of proving whether a more uniform and regular steel is not thereby obtained.

OVERHEATED STEEL.

By Arthur Windsor Richards (Grangetown)
and John Edward Stead, F.R.S., Member
of Council.

(Abstract.)

In view of the fact that there still exists much confusion in the minds of many metallurgists as to the definition of the term overheating as applied to steel, and as to whether or not reheating overheated steel can invariably be relied upon to restore good properties to such brittle material, the authors present a review of the opinions of those who have specially studied the question, and supplement their previous work on this subject by further experiments in the hope that some of the confusion may be removed.

The confusion existing appears to have arisen by confounding "burnt" with "overheated" steel, and it certainly seems to the authors that this will disappear if the following definitions of overheating and burning are accepted, viz.—

Overheating is heating at any point below that which produces incipient disintegration and results in the formation of large crystals.

Burning is heating at or above the point at which such disintegration occurs; burnt steel is nearly always coarsely crystalline.

If these definitions are accepted, the following facts should be remembered—

(1) That all overheated steel is more or less coarsely crystalline.

(2) That different steels apparently of the same composition vary in their susceptibility to disintegration. At a given high temperature one may be simply overheated whilst another may be burnt or partially disintegrated.

(3) That burnt steel cannot be completely restored by reheating; it can be greatly improved, but is never equal to reheated steel which has not suffered partial disintegration.

As an example of such burnt steel before and after heat treatment the accompanying photomicrographs are given, in which it is shown that some of the broad ferrite sheets or bands remain after reheating, and these are divided centrally by some substance quite foreign to the steel proper. On attempting to bend this steel the ferrite bands broke up along the line or plane of the foreign substance, and this of course led to sudden fracture through the whole mass. Such burnt steel is only fit for the same kind of work as it is worthless until it has again passed through the fluid state.

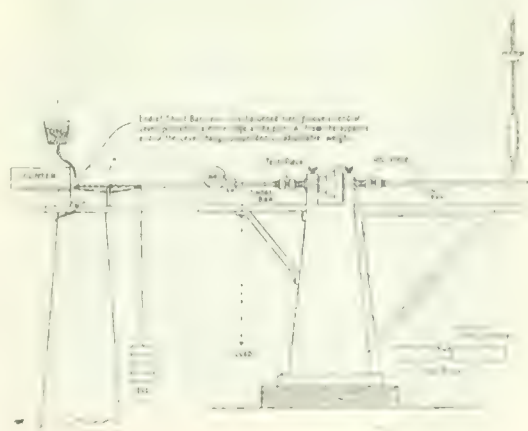
GENERAL DESCRIPTION OF WORK DONE.

In their latest research, instead of working upon rails, the authors mainly confined their work to the treatment of 1-in. square rolled bars. The tests applied included:—

(1) Testing for maximum tenacity and elongation in a 50 ton Buckton machine having a hydraulic cylinder driven from an accumulator and belt-driven pump coupled to a motor running at a constant speed; (2) ordinary bending tests; (3) alternate bending of strips, having a section 6 millimetres by 3 millimetres, through an angle of 40 deg.; (4) rotary bending through a constant slight angle, of round pieces of the same dimensions as those used for fibre stress testing described in (5); (5) testing by reversals of stress, by the Wöhler method, on an improved machine built by Messrs. Richardson, Westgarth, and Co. to designs supplied by the authors.

The machine consists of a strong steel spindle on which are mounted three pulley wheels, giving speeds of 800, 1,200, and 2,400 revolutions per minute when driven by a suitable motor. The spindle moves in massive bearings, and each end terminates in a modified form of self-centring chuck in which the test-pieces are securely fastened.

To one end of the machine is attached a short steel bar 10 in. long, also with suitable chuck, which is connected to the spindle by the test piece, one end of the bar running free, and having a groove in which is loosely fitted one end of a hardened steel lever carrying the load used in testing. The other end of the machine is similarly fitted, the bar being 42 in. long, and the load is applied by means of a spring



RICHARDS AND STEAD'S MACHINE FOR TESTING STEEL BY REVERSAL OF STRESS AND STRAIN.

	Series G	Series H
Carbon	Per Cent	Per Cent
0.20	0.44	0.44
0.20	0.44	0.44
0.20	0.44	0.44
0.20	0.44	0.44

THE AUTHORS' ANALYSIS OF STEELS.

holder following the plan of Professor Ewing and Mr. Humphrey. A suitable counter for recording the number of revolutions is also attached.

In reviewing the results of their experiments as shown in the accompanying tables what appears to be most remarkable to the authors, is the fact that the indications obtained by all systems of testing prove that overheating reduces the power of the steel to resist fatigue; that reheating such steel more than restores the original good qualities of the rolled bars; and that when the steel has the carbon in the sorbitic condition its power of endurance is more than doubled.

The results amply confirm those published in their previous paper.

HEAT TREATMENT OF A BROKEN AXLE

By permission of Mr. James Holden of the Great Eastern Railway Company, the authors also describe experiments made to determine the effect of heat treatment on a wagon axle which broke at a flaw after being in use for twenty years.

During this period it had travelled probably 300,000 miles, and had been subjected to 200,000,000 reversals of stress. The flaw which initiated fracture appears to have been a deep stamp mark.

The weakness produced initially by this deep impression, in the authors' opinion, eventually led to a fatigue fracture, which travelled from the upper to the convex termination. Sudden or granular fracture followed through the remaining part of the mass. The inference is that had there been no such excessively deep stamp impression the axle could not have failed.

According to the fibre stress testing, the normal steel of rather coarse crystalline structure is relatively weak, but, for all that, it is good material, and calculated to be quite strong enough to stand all the normal working stresses.

It is pointed out that proper heat treatment very greatly increases the fatigue-resisting properties of the steel and that ordinary tensile tests which do not show the yield points fail to give a hint as to the relative value of steels in their power to resist fatigue.

TABLE 7.

	Age 1	Overheat	Reheat	Elongation	Per Cent	Fracture
	Normal	Overheat	Reheat	Normal	Overheat	Reheat
1	11.75	24.80	62.00	33.00	60.85	67.10
2	13.85	24.30	60.40	40.00	67.10	70.90
3	15.05	23.00	66.20	47.00	70.90	74.70
4	16.25	21.50	62.70	54.00	74.70	78.50
5	17.45	20.00	59.20	61.00	78.50	82.30
6	18.65	18.50	55.70	68.00	82.30	86.10
7	19.85	17.00	52.20	75.00	86.10	89.90
8	21.05	15.50	48.70	82.00	89.90	93.70
9	22.25	14.00	45.20	89.00	93.70	97.50
10	23.45	12.50	41.70	96.00	97.50	101.30
11	24.65	11.00	38.20	103.00	101.30	105.10
12	25.85	9.50	34.70	110.00	105.10	108.90
13	27.05	8.00	31.20	117.00	108.90	112.70
14	28.25	6.50	27.70	124.00	112.70	116.50
15	29.45	5.00	24.20	131.00	116.50	120.30
16	30.65	3.50	20.70	138.00	120.30	124.10
17	31.85	2.00	17.20	145.00	124.10	127.90
18	33.05	0.50	13.70	152.00	127.90	131.70
19	34.25	0.00	10.20	159.00	131.70	135.50
20	35.45	0.00	6.70	166.00	135.50	139.30
21	36.65	0.00	3.20	173.00	139.30	143.10
22	37.85	0.00	0.00	180.00	143.10	146.90
23	39.05	0.00	0.00	187.00	146.90	150.70
24	40.25	0.00	0.00	194.00	150.70	154.50
25	41.45	0.00	0.00	201.00	154.50	158.30
26	42.65	0.00	0.00	208.00	158.30	162.10
27	43.85	0.00	0.00	215.00	162.10	165.90
28	45.05	0.00	0.00	222.00	165.90	169.70
29	46.25	0.00	0.00	229.00	169.70	173.50
30	47.45	0.00	0.00	236.00	173.50	177.30
31	48.65	0.00	0.00	243.00	177.30	181.10
32	49.85	0.00	0.00	250.00	181.10	184.90
33	51.05	0.00	0.00	257.00	184.90	188.70
34	52.25	0.00	0.00	264.00	188.70	192.50
35	53.45	0.00	0.00	271.00	192.50	196.30
36	54.65	0.00	0.00	278.00	196.30	200.10
37	55.85	0.00	0.00	285.00	200.10	203.90
38	57.05	0.00	0.00	292.00	203.90	207.70
39	58.25	0.00	0.00	299.00	207.70	211.50
40	59.45	0.00	0.00	306.00	211.50	215.30
41	60.65	0.00	0.00	313.00	215.30	219.10
42	61.85	0.00	0.00	320.00	219.10	222.90
43	63.05	0.00	0.00	327.00	222.90	226.70
44	64.25	0.00	0.00	334.00	226.70	230.50
45	65.45	0.00	0.00	341.00	230.50	234.30
46	66.65	0.00	0.00	348.00	234.30	238.10
47	67.85	0.00	0.00	355.00	238.10	241.90
48	69.05	0.00	0.00	362.00	241.90	245.70
49	70.25	0.00	0.00	369.00	245.70	249.50
50	71.45	0.00	0.00	376.00	249.50	253.30
51	72.65	0.00	0.00	383.00	253.30	257.10
52	73.85	0.00	0.00	390.00	257.10	260.90
53	75.05	0.00	0.00	397.00	260.90	264.70
54	76.25	0.00	0.00	404.00	264.70	268.50
55	77.45	0.00	0.00	411.00	268.50	272.30
56	78.65	0.00	0.00	418.00	272.30	276.10
57	79.85	0.00	0.00	425.00	276.10	279.90
58	81.05	0.00	0.00	432.00	279.90	283.70
59	82.25	0.00	0.00	439.00	283.70	287.50
60	83.45	0.00	0.00	446.00	287.50	291.30
61	84.65	0.00	0.00	453.00	291.30	295.10
62	85.85	0.00	0.00	460.00	295.10	298.90
63	87.05	0.00	0.00	467.00	298.90	302.70
64	88.25	0.00	0.00	474.00	302.70	306.50
65	89.45	0.00	0.00	481.00	306.50	310.30
66	90.65	0.00	0.00	488.00	310.30	314.10
67	91.85	0.00	0.00	495.00	314.10	317.90
68	93.05	0.00	0.00	502.00	317.90	321.70
69	94.25	0.00	0.00	509.00	321.70	325.50
70	95.45	0.00	0.00	516.00	325.50	329.30
71	96.65	0.00	0.00	523.00	329.30	333.10
72	97.85	0.00	0.00	530.00	333.10	336.90
73	99.05	0.00	0.00	537.00	336.90	340.70
74	100.25	0.00	0.00	544.00	340.70	344.50
75	101.45	0.00	0.00	551.00	344.50	348.30
76	102.65	0.00	0.00	558.00	348.30	352.10
77	103.85	0.00	0.00	565.00	352.10	355.90
78	105.05	0.00	0.00	572.00	355.90	359.70
79	106.25	0.00	0.00	579.00	359.70	363.50
80	107.45	0.00	0.00	586.00	363.50	367.30
81	108.65	0.00	0.00	593.00	367.30	371.10
82	109.85	0.00	0.00	600.00	371.10	374.90
83	111.05	0.00	0.00	607.00	374.90	378.70
84	112.25	0.00	0.00	614.00	378.70	382.50
85	113.45	0.00	0.00	621.00	382.50	386.30
86	114.65	0.00	0.00	628.00	386.30	390.10
87	115.85	0.00	0.00	635.00	390.10	393.90
88	117.05	0.00	0.00	642.00	393.90	397.70
89	118.25	0.00	0.00	649.00	397.70	401.50
90	119.45	0.00	0.00	656.00	401.50	405.30
91	120.65	0.00	0.00	663.00	405.30	409.10
92	121.85	0.00	0.00	670.00	409.10	412.90
93	123.05	0.00	0.00	677.00	412.90	416.70
94	124.25	0.00	0.00	684.00	416.70	420.50
95	125.45	0.00	0.00	691.00	420.50	424.30
96	126.65	0.00	0.00	698.00	424.30	428.10
97	127.85	0.00	0.00	705.00	428.10	431.90
98	129.05	0.00	0.00	712.00	431.90	435.70
99	130.25	0.00	0.00	719.00	435.70	439.50
100	131.45	0.00	0.00	726.00	439.50	443.30

* Although this treatment is very liable to produce water cracks, none were produced in our experiments. Further trials are in progress to ascertain the best possible method of producing sorbitic steel.

OVERHEATED STEEL.

Ordinary Bend and Tensile Tests.

Section	Radius of bend, in millimetres, by 3-m. gages,		
	F	G	H
Normal	radius of bend 6.50	7.25	8.00
Overheated	" " 7.00	7.50	12.25
Reheated	" " 6.00	6.50	6.40
Annealed	" " 6.00	6.00	7.00
Sorbitic	" " 6.00	6.00	6.00

Rotary Bending through an Angle of 6 Degrees.
Revolutions per Minute 1200.

Series		Total Revolutions to Produce Fracture.	Comparison on Normal = 1
E 1	Carbon 0.06 normal .	3500	1.0000
E 2	.. overheated .	2500	0.7143
E 3	.. reheated .	3750	1.0714
E 4	.. annealed .	2680	0.7657
G 1	Carbon 0.48 normal .	3940	1.0000
G 2	.. overheated .	2040	0.5178
G 3	.. reheated .	5000	1.2690
G 4	.. annealed .	5120	1.3000
H 1	Carbon 0.44 normal .	3660	1.0000
H 2	.. overheated .	2207	0.6030
H 3	.. reheated .	5500	1.5027
H 4	.. annealed .	5215	1.4251
I 1	.. sorbitic .	4280	1.1722

HYPOTHETICAL CONCLUSIONS

The paper concludes as follows:

It is impossible to refrain from endeavouring to explain how it is that overheated steel should be so weak and non-resistant to the continued application of reversals of stresses and strains as compared with the same material in the normal and restored condition. In doing this the following facts must be taken as basis:—

(1) That in the normal and restored material the crystalline structure is in each case fine, whereas it is coarse in the overheated steels.

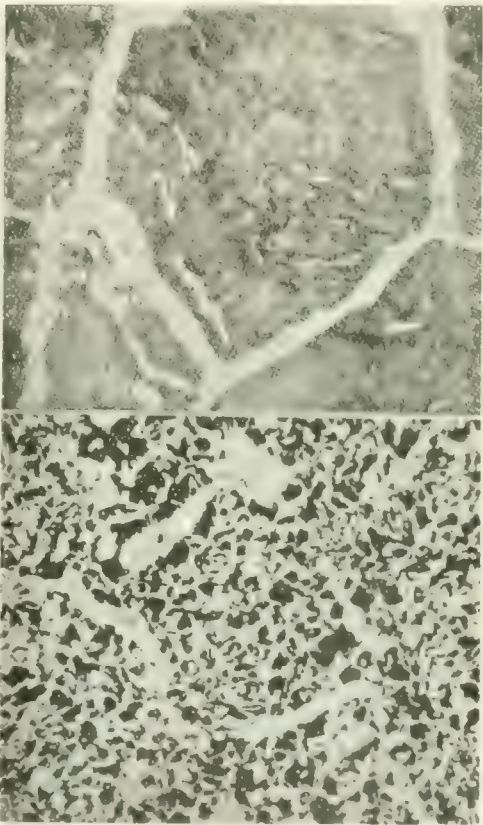
(2) That in series G, H and I, the crystal grains of large dimensions in the overheated steels were surrounded by more or less complete envelopes of massive free ferrite, and that in series I the grains enclosed by these envelopes were cut up by plates or sheets of the same substance.

(3) That on bending the polished and etched specimen of the overheated steel backward and forward it was easily observed under the microscope that the extension or distortion during the bending was mainly confined to the massive ferrite envelopes and sheets. At first they appeared to sink below the surface, and eventually developed into actual fissures or incipient cracks; an observation confirmed by Mr. Jenkins in the case of the broken axle.

(4) The researches of Professor Ewing, Messrs. Humfrey, A. E. Seaton,* and A. Jude have proved that fracture of steel when under the influence of long continued fatigue or under sudden shock is initiated in the free ferrite, and generally travels continuously as far as possible along a track in which there is the greatest amount of that constituent, in fact along the line of least resistance.

(5) That in pure or nearly pure commercial carbon steels the ferrite has a yield point of probably not more than eight to twelve tons per square inch, whereas the other constituent, pearlite, does not sensibly yield until a tension of about twice these amounts is reached, excepting when its structure is composed of broad sheets of ferrite and carbide of iron, for in such case the ferrite behaves as if it were massive, and the yield point is necessarily much lower.

(6) The weakness of a steel under stress in any given direction depends on the manner in which the ferrite and pearlite are arranged with relation to the stresses applied. For instance, in large forgings it not infrequently happens that the ferrite and pearlite are arranged in more or less continuous bands or sheets. If a polished and etched section is bent slightly at right angles to the plane of these,



The upper section is of a Bar of Mild Steel, the lower is a section of a Bar of Mild Steel, same as No. 1, 1000, Reheated to and Cooling from 850°C.

* Report on the Work of the Institution of Mechanical Engineers, 1904, p. 10.

and is then examined it will be found that the ferrite bands are depressed below the surface, whilst the lines of pearlite remain in relief. On attempting to bend to any great extent, the piece will break at a very poor angle. If, however, bending is effected with the fibre, the steel will bend quite close without fracturing. If such a steel is heated to a sufficient temperature so as to cause the carbon to be regularly diffused through what was originally massive ferrite, and it is then quenched in water and reheated to 650 deg. C., it will bend close equally in each direction, provided that there is a complete absence of strings or plates of sulphide or silicate of manganese.

To make the point clearer by a hypothetical case, let us assume that a bar of pearlite is divided midway between its ends by a plate of ferrite $\frac{1}{16}$ in. in thickness, and is perfectly united with the pearlite on each side of it. If this bar were to be submitted to tension, the ferrite would begin to extend and sink below the surface, and when it had extended as far as its nature would admit, it would break before the elastic limit of the pearlite was reached. The extension of the whole bar would be very slight, but that of the ferrite plate would be probably 20 per cent. or more. The tenacity would be that of the ferrite. In such a case the ferrite would be the exact equivalent to the weakest link in a chain.

With these facts before us, it is not difficult to explain the weakness of coarsely crystalline structural steels. The comparatively massive and continuous sheets of ferrite approach more or less nearly to the actual and supposititious cases referred to of ferrite between pearlite. When under stresses which are below the yield point as determined by the testing machine, but which cannot be below that of the ferrite, they are concentrated on these broad bands, movements backward and forward, with each reversal of stress, occur between the particles of the soft ferrite, till eventually incipient fracture is started, and, once begun, it rapidly travels through ferrite and pearlite alike until a complete separation of the mass is effected. One broad plate of ferrite with planes at right angles to the direction of tension and compression will be sufficient to initiate fracture, and after this has actually broken there will be a very weak place where the stresses will be mainly concentrated, and the crack will grow to complete fracture.

In this way is explained why it is that the steel immediately adjoining a fatigue fracture is usually found to be practically as good as it was when first put in. The stresses soon find out the weak spot, and make it weaker and weaker by being continually

concentrated there, whilst the adjoining material is practically not affected or weakened.*

In the case of overheated steels containing above 1 per cent. carbon, the brittle envelopes of carbide of iron which surround the grains or which pass through their substance are the places along which fracture most readily travels.

Overheated steels consisting entirely of pearlite are very brittle, and probably fracture is initiated in the plates of carbide.

Ingot iron may be made coarse-grained and brittle by long-continued heating at temperatures below Ac₃-870 deg. C., if the carbon is very low, and if it exceed 0.10, by heating at a very high degree of heat. In either case the steel is weak, and fracture is initiated between the cleavage planes of the ferrite when subjected to stresses and strains.

On the other hand, when the crystals are fine and the ferrite exists in minute crystals and are heterogeneously oriented and are intimately distributed with the pearlite throughout the mass, the strength of the two constituents are averaged, the lines of stress pass over a multitude of each of them, and the pearlite being the stronger, supports the ferrite and prevents it breaking down.

If these conclusions are right, it seems obvious that it would be an ideal condition if free ferrite were absent in carburised steels which have to be subjected to severe vibratory stresses. Ordinary structural steels in this condition can be obtained by heating to a suitable temperature, quenching, and reheating at a lower temperature. The example described as sorbitic steel was prepared in that way. It was devoid of free ferrite, and it will be seen that it has double the resisting power of the normal forged bars.

The authors emphasise the fact that they do not maintain that steel initially bad, brittle, and dangerous, owing to irregularity in the distribution of the elements, or from other causes which have not yet been explained, can be made good by any kind of heat treatment. What they believe has been proved conclusively is that good steels which have been heated to any point short of incipient disintegration, and made excessively brittle by such treatment, can be completely restored to perfectly sound and reliable material. Also, that it is safest to heat to a temperature about 50 deg. above the critical points to ensure the complete change of every portion of the steel, excepting in the case of the purest and most homogeneous steels, when the temperature of the upper critical points need not be greatly exceeded.

* There are, as we have proved, exceptions to this rule.

THE OCCURRENCE OF COPPER, COBALT AND NICKEL IN AMERICAN PIG IRONS.

By Edward Demille Campbell (Michigan University).

(Abstract.)

Although copper, cobalt, and nickel probably occur in small amounts in most pig irons, they are not usually determined, and it is owing to this fact that so few analyses are found in which these elements are reported. The literature containing analyses of pig iron reveals but forty-two analyses in which any of the above elements are given, and in nine cases only are cobalt and nickel together reported. The amount of copper, cobalt and nickel occurring in European irons, so far as is shown by analyses already published, is given in Table I.

Some time ago samples of pig iron were procured from charcoal or coke blast-furnaces situated in various parts of North America, especially in the United

States. The samples were procured from those furnaces only which used ore from a limited region, as the object of the work was to determine the extent to which copper, cobalt and nickel occurs in pig iron made from ore found in the different districts. The results of careful analyses are shown in Table II.

Two points of interest are brought out by a study of these results. First, the fact that the two samples Nos. 3 and 4, made from ores from the Lake Superior district, contain no copper, cobalt, or nickel, although the Gogebic range is comparatively near the great copper-producing district of Lake Superior. The second point relates to samples Nos. 6 and 8. These two irons, it will be noted, are the only ones containing any considerable amount of cobalt or nickel, and both of these irons have gained a reputation for their valuable properties for car-wheel castings. We have no information in regard to the influence of small amounts of cobalt or nickel on the properties of cast iron, and the occurrence of these elements in these two irons mentioned may be a mere coincidence, but it is at least suggestive.

Material.	Source.	Per Cent. Copper.	Per Cent. Co and Ni.	Analysis.
1. Hot-chamber pig.	France.	0.11		Turne's "Metallurgy," p. 534.
"	"	0.10		"
"	"	0.10		"
2. Forge.	"	0.11		"
3. Mottled.	"	0.10		"
4. Spiegeleisen.	England, Ireland and Germany.	0.014		Percy's "Metallurgy," p. 534.
5. Mottled pig.	Germany.	trace		"
"	"	0.015		"
6. Mottled pig.	Germany.	0.014		"
7. Mottled pig.	"	0.060	0.090	"
"	"	0.045	0.110	Percy's "Metallurgy," p. 532.
"	"	0.064		"
8. Hot-chamber pig and blast, from very rich ore.	South Africa.		0.005	"
9. Hot-chamber pig and blast, from very rich ore.	"		0.004	"
10. Hot-chamber pig and blast, from very rich ore.	"		0.003	"
11. Hot-chamber pig and blast, from very rich ore.	"		0.007	"
12. White forge.	Germany.	0.14		"
13. Grey forge.	"	0.08		"
14. Spiegeleisen.	"	0.15		"
15. " "	"	0.12		"
16. " "	"	0.19		"
17. " "	"	0.18		"
18. " "	"	0.310		"
19. Hot-chamber pig and blast, from very rich ore.	Eisenerz, Austria.	trace		"
20. Hot-chamber pig and blast, from very rich ore.	"	trace		"
21. Grey pig.	Germany.	0.011	trace	"
22. White pig.	Germany.	0.011	trace	"
23. White pig.	"	trace		"
24. White pig.	"	trace		"
25. Low phosphorus.	Hungary.	0.04	0.000 Ni	"
26. White pig.	Austria.	0.000		"
27. Spiegeleisen.	Marseilles, France.	0.009		"
28. Spiegeleisen.	"	0.004		"
29. Ferro-silicon.	"	0.000		"
30. Ferro-silicon.	"	trace		"
31. Ferro-silicon.	"	0.11		"
32. Ferro-manganese.	"	0.06		"
33. Ferro-manganese.	"	0.06		"
34. Charcoal pig.	Ural District, Russia.	0.01	0.08	"
35. Charcoal pig.	"	0.11		"

TABLE I. THE OCCURRENCE OF COPPER, COBALT AND NICKEL IN EUROPEAN PIG IRONS.

THE NATURE OF TROOSTITE.

By Dr. Carl Benedicks (University of Upsala).

The existence of troostite can certainly not be questioned, but opinions as to its nature are divided. Boynton has recently discussed troostite in a paper on micrography, and has come to a strange conclusion as to its real nature. Both Osmond and Le Chatelier have rejected this conclusion, and quite recently Kourbatoff, in a summary of his valuable experimental results, has further laid stress upon the untenability of Boynton's views, and which he has substituted another hypothesis.

The author's paper is chiefly into consideration of the nature of troostite and analogies to troostite. He points out that the terms troostite and sorbite are used without any consistency. In reality no essential difference has hitherto been shown to exist between these constituents. For a detailed knowledge of the formation of troostite, he says, we require still more experimental investigations, in particular the determination of the rapidity with which a steel on hardening goes through different intervals of temperature—an investigation such as that which Le Chatelier has recently set on foot—and the establishment of the influence of foreign substances on the formation of troostite.

However, more important and interesting problems seem to lie before us, and it appears advisable to wait for a detailed account of the liquid colloid solutions, with which troostite seems to have an unmistakable analogy, and details of which are more accessible.

In conformity with the experimental works of Osmond, Le Chatelier, Heyn, Boynton, and Kourbatoff, and with his own observations, the author tells us he is led to the following conclusions:—

Everything we know at present points to the fact that Osmond has quite correctly defined troostite as an intermediate form between martensite and pearlite.

Between troostite and pearlite there is a continuous transition, and one is naturally led to the conclusion that troostite is a pearlite with ultra-microscopically small particles of cementite (containing also more or less hardening carbon). This hypothesis is the simplest and the most natural one to accept until it be shown that it is contrary to truth.

This is in keeping with the fact of the extreme case with which troostite is affected by reagents, with its varying hardness, which lies between that of martensite and that of pearlite, and with the fact that troostite, from a steel rich in carbon, yields cementite when slightly heated, as Kourbatoff has shown.

In all probability troostite is formed by a transformation *in situ* of martensite, which implies that the carbon it contains must be the same as in the martensite from which it originates.

Boynton's assumption that troostite is pure β iron is without experimental or theoretical support. Similarly Kourbatoff's suggested theory, that troostite is a solution of elementary carbon in iron, is untenable.

Troostite is formed from martensite by the appropriate lessening of the intensity of the hardening, especially in places that are in contact with ferrite or cementite; this is in perfect conformity to theoretic requirements.

As far as we can judge, troostite offers in the domain of alloys an interesting analogy to the colloid solution.

Since the above was written, Rogers, in a paper on troostite, has taken into consideration the different arguments in favour of troostite containing carbon, contrary to Boynton's hypothesis. He says, however, that he fails to see why troostite should be β iron rather than γ .

No.	Kind of Ore.	Source of Ore.	Fuel used.	Per Cent. Copper.	Per Cent. Cobalt.	Per Cent. Nickel.
1	Mixed magnetic hæmatite and magnetite	Nova Scotia	Coke	0.011	0.012	0.015
2	Local hæmatites	Mexico	Charcoal	0.012	0.009	0.006
		U.S.A.:—				
3	½ Menabé, ½ Vermilion Range	Minnesota	Coke	—	nil	—
4	Gogebic hæmatite	Wisconsin	Charcoal	—	nil	nil
5	Magnetic concentrates	New York	Charcoal	0.039	trace	—
6	Salisbury brown hæmatite	Connecticut	Charcoal	0.018	0.029	trace
7	½ Local hæmatite ½ magnetite	Virginia	Coke	0.169	trace	0.009
8	Local brown hæmatite	Alabama	Charcoal	0.008	0.008	0.012
9	Native hæmatite and magnetite	Colorado	Coke	0.039	ni.	—

TABLE II. COPPER, COBALT AND NICKEL IN AMERICAN PIG IRONS.

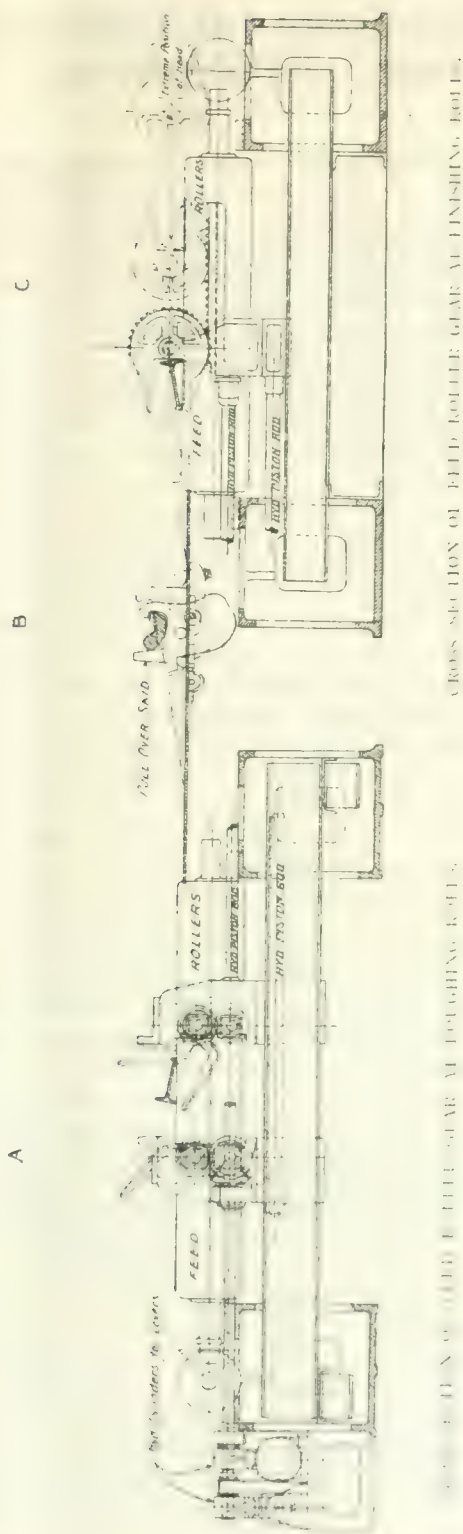
A MANIPULATOR FOR STEEL BARS.

By Douglas Upton Jarrold.

It is constantly increasing the demand for the manufacture of sections to consider the adoption of mechanical means of handling bars during the process of manufacture. In a mill rolling a great variety of sections the problem is one of extreme difficulty, owing to the various motions required, any single apparatus capable of doing all that is required in such a mill would be of an extremely complicated nature, so much so indeed as to impair its usefulness owing to the probability of breakdown and the constant attention which would be required to keep it in anything like order.

In the invention about to be described very briefly, this difficulty has, it is claimed, been overcome by employing a series of three machines, the first of which consists of two pairs of movable heads which are installed at each side of the roughing and finishing rolls. These heads can move in either direction parallel to the rolls. They are, preferably, actuated by hydraulic cylinders, and they place the piece in position for entering any required pass. These heads moreover, are fitted with levers for turning the piece up for edging purposes; not only will they turn the piece up, but without actually gripping it, will maintain it in that position until it enters the rolls. The heads are shown at A.

In addition to edging, however, nearly all the larger sizes require to be turned completely over once, or oftener, during the process of rolling. The rolls employed are so designed, however, that the first turnover does not take place until the bar has left the roughing rolls and before it enters the finishing. The second of the three machines has been correspondingly designed, therefore, to do this turning over of the piece between the roughing and finishing rolls. B indicates how this result is obtained. It will be seen that as the bar is being pushed over from the roughing to the finishing rolls it is caused to move up a slight incline until the outer edge of the bar is engaged by what may be termed the hook of a tumbler. As the bar is pushed farther forward this tumbler rotates, and finally the piece, of whatever shape, is turned completely over, ready for entering the first pass of the finishing rolls. In point of fact, the time occupied in this double operation of skidding and turning over the piece is not longer than that usually occupied in merely skidding the piece across according to the old method. Hence the time formerly occupied in



When rolling sections such as large bulb tees it is necessary to turn the bar completely over at each side of the finishing rolls, and for this purpose the machine C has been designed. It consists, briefly, of a head capable of being moved in either direction parallel to the rolls. This head carries a segmental body provided with teeth which engage with a rack so that partial rotation of the body about a horizontal axis at right angles to the rolls can be obtained in any position of the head. The turning over of the bar is performed by moving the head so that the segmental body engages the bar which it holds in position without gripping. On rotating the body by means of the rack the bar can be turned completely over and at the same time brought directly opposite the next pass in the rolls—the whole operation only occupying a fraction of the time previously required with manual labour.

So far as experience goes, these appliances have been found to answer all the purposes required in the large mill in which they have been used. They have reduced the rolling staff from ten men, on ordinary sections, to five, and on some of the larger sections even greater reductions in the number of men have been effected. Beyond watching the guards and guides of the mill generally, the men whose services have been retained have very little to do, and the hard, laborious work which they had to perform at times is now done in a fraction of the time by the machines described. The output of all classes of sections has been increased very considerably, the material being finished so much hotter, much less steam is required to drive the mill, and there are no cobbles due to delay in handling heavy sections. There is less dressing of rolls; and, as to the life of the rolls, it may be mentioned that before this manipulating arrangement was designed, the breakage of bulb tee rolls was very heavy, averaging about one roll to every 400 tons manufactured. Since starting the manipulators some thousands of tons of bulb tees have been rolled, and not a single roll has been broken. This is a matter of great interest to all makers of sections; especially those who manufacture the larger and more awkward sizes, and a model is shown which fully illustrates the machinery and all that it is capable of doing.

Owing to pressure upon our space several abstracts are held over until next week.

Messrs. Princeps and Co., of Princeps Works, Sheffield, have appointed Mr. A. S. Mumme, of 95, Leadenhall-street, as sole agent for London and district for their piston rings, metallic packings, etc.

MORE ABOUT THE SHEEPBRIDGE COAL AND IRON WORKS.

The history of these important works makes interesting reading. In the year 1856 the late Mr. William Fowler, of Whittington, near Chesterfield, acquired leases of certain areas of coal near Chesterfield. For the purpose of developing these minerals and erecting ironworks he was joined by his brother, Mr. John Fowler (afterwards Sir John Fowler, the celebrated civil engineer), and Mr. Arthur Hankey, of London who constituted themselves the Dunston and Barlow Company. The "Blackshale" and "Potters" coal were developed, the former being used principally in the blast furnaces.

In 1864 the Sheepbridge Coal and Iron Company, Ltd., was formed to purchase the business of the Dunston and Barlow company. Mr. William Fowler, the first chairman of the new company, held that position until his death in 1877, when he was succeeded by the late Mr. Henry D. Pochin, who was largely interested in the company. Mr. Frederick Fowler of Sheffield, became chairman on the death of Mr. Pochin in 1895, and still occupies that position.

Up to the year 1896, the blast-furnaces, of which there were eight in number, were of the usual Derbyshire type, being 52 ft. high, with a weekly production of 280 to 300 tons per furnace.

In the early stages of the concern a good deal of native ironstone from the coal measures was used, but in later years this became too expensive, and in order to produce a cheap pig iron ironstone, mines which were in the oolitic formation in Northamptonshire, Rutlandshire and North Lincolnshire, were acquired, from which source the supply of iron ore has been very largely obtained for many years past.

In the early seventies the coal supplies were indicating signs of exhaustion, and the company procured a large tract of the celebrated "Barnsley" or "Top Hard" coal from ten to twelve miles further to the east of this property, where they sank the famous Langwith and Clapwell Collieries, which now produce an output of over 4,000 tons per day.

The Norwood Colliery, on the Borders of South Yorkshire, and working the same coal, was established in 1868. The company have since extended their coalfields into South Yorkshire, where, in association with the Sheffield Coal Company, Ltd., they have recently sunk a large colliery at Dinnington.

To the north of Dinnington the company have acquired another large area of the "Barnsley" coal, extending to nearly 10,000 acres.

OUR WEEKLY BIOGRAPHY.

COLONEL HENRY CAPEL LOFFT HOLDEN, Royal Artillery, M.I.E.E., F.R.S.

COLONEL HOLDEN, the eldest son of the late Dr. H. A. Holden, the eminent classical scholar, was born at Cheltenham in 1856. He received his primary education at Queen Elizabeth's School, Ipswich, and having passed the entrance examination in 1875, was enrolled as a student of the Royal Military Academy, Woolwich. Two years later he obtained his commission as a lieutenant in the Royal Artillery and in 1877 he went to India with B battery of the 24th Brigade.

He remained in India for some five years, during which time he made a study of telegraphy, also the then new science of telephony, and made a number of experiments on a private line which the Indian Government had granted him permission, as a special favour, to construct.

In 1882 he returned to England and underwent the long course of training in gunnery at Shoeburyness, during which time he delivered a series of lectures to his brother officers on the practical applications of electricity. A year later Colonel Holden was selected on account of his electrical knowledge for appointment to the Experimental Department of the Director of Artillery, and on completion of some important work in connection with the coast defences of this country, was appointed the Proof Officer of the Royal Gun Factory at Woolwich. When the Inspection Branch of the Army was formed in 1888, he was appointed an Inspector of Guns and Steel, and Proof Officer, and from that time until 1899 he was head of the department which controls and carries out the proving of all our guns and testing of all our powders. During this period he not only reorganised all the appliances and

methods used for testing and brought them up-to-date, but also founded and equipped with instruments and apparatus of his own design the Experimental Establishment which is now controlled by the Explosives Committee. For this service he was rewarded by H.M. Government in 1902.

Colonel Holden has invented and designed many electrical instruments and other apparatus connected with artillery. He was



COLONEL H. C. L. HOLDEN.

deputed by the Secretary of State for War to visit and report upon the war material and electrical appliances at the Paris Exhibition of 1889, and for a similar purpose visited the Frankfurt Electrical Exhibition of 1891. In 1893 he was deputed to report upon the electrical and war materiel exhibits at the World's Fair, Chicago, and also to visit private and government factories in the United States and again was selected to report upon the Paris Exhibition of 1900. He was elected a fellow of the Royal Society in 1895, and is at present a Member of the Council of the Institution of Electrical Engineers as well as of the Society of Arts.

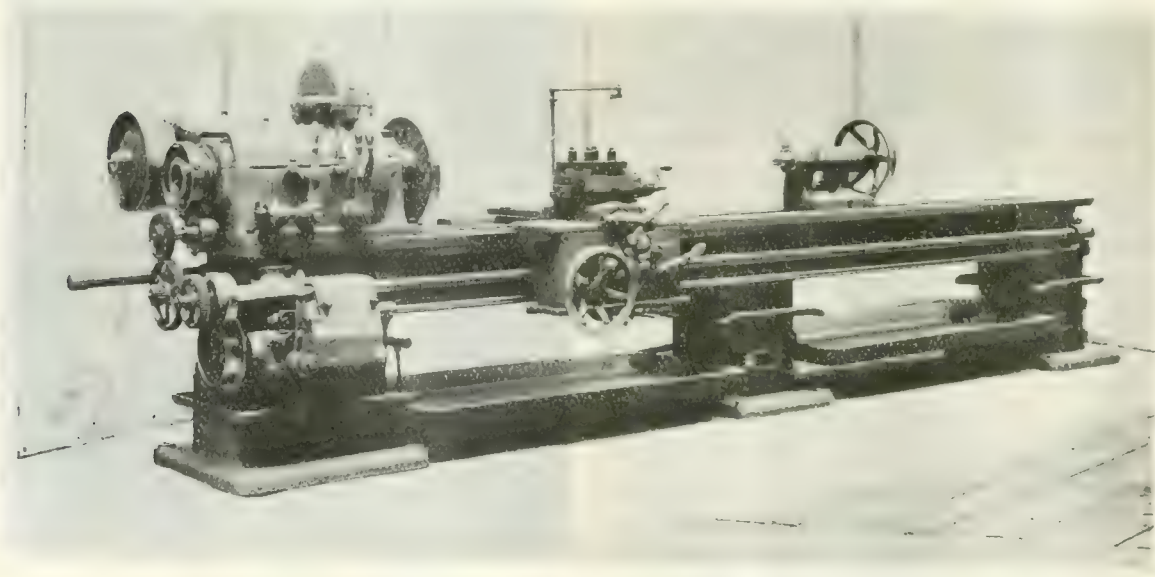
Colonel Holden has identified himself with the rise and progress of automobilism, and during 1904 was the Chairman of the Automobile Club of Great Britain and Ireland, as also of the Motor Union, and also represented Great Britain in the International Commission of the present year. He is a member of various sub-committees of the Engineering Standards Committee, representing the War Office in an official capacity, and he had been in charge of the Royal Gun Factories at Woolwich Arsenal since 1896.

HIGH-SPEED SPINDLE LATHE FOR THE BIRMINGHAM UNIVERSITY.

BY courtesy of the Tangey Tool and Electric Company, Ltd., Birmingham, we reproduce a view, not previously published, of a high-speed lathe made by the company for the Birmingham University.

The lathe has centres $8\frac{1}{4}$ in. high, the bed being 14 ft. 6 in. long to admit 9 ft. between the centres. The fast headstock is of the firm's gear type, and is driven by a constant-speed belt with a single pulley 14 in. diameter for a 4 in. belt. Great belt power is thus obtained, and the belt itself is not shifted for change of speed. The pulley is carried on a separate shaft at the back of the lathe, and thus the pull of the belt is removed entirely from the lathe spindle.

The headstock gearing is completely enclosed, so that dirt or cuttings cannot possibly get into the gearing. Screw-cutting operations are obtained from a separate screw kept for this purpose, the reverse motion being arranged inside the fast headstock. The latter has sixteen speeds, ranging in regular order from



HIGH-SPEED LATHE FOR THE BIRMINGHAM UNIVERSITY.

400 revolutions down to 8 revolutions a minute, and the changes can be made quickly and easily.

For turning large diameters the maximum purchase is 39 to 1, so that heavy cuts can be taken on the largest job that can swing in the lathe. The loose headstock has a steel spindle 3 in. diameter, and has cross adjustment by screw for slight taper turning. The saddle has self-acting sliding and surfacing motions driven from a shaft in front, which can be quickly connected or disconnected by means of friction cones at the front of the saddle.

By means of the gear box at the left-hand end

of the lathe the spindle can be changed to any speed, giving 8, 12, 18, 32, 48, and 72 revolutions for each inch of traverse. A separate stop motion is also fitted by means of a drop worm, so arranged that this motion can be applied at any time if required. A large handwheel is provided for moving the saddle quickly by hand, and the compound slide rest is arranged to swivel for taper turning.

This lathe has been specially arranged for quick handling and very large output. It is supplied with a very complete arrangement of pumps, trays, etc., for catching the suds and oils.

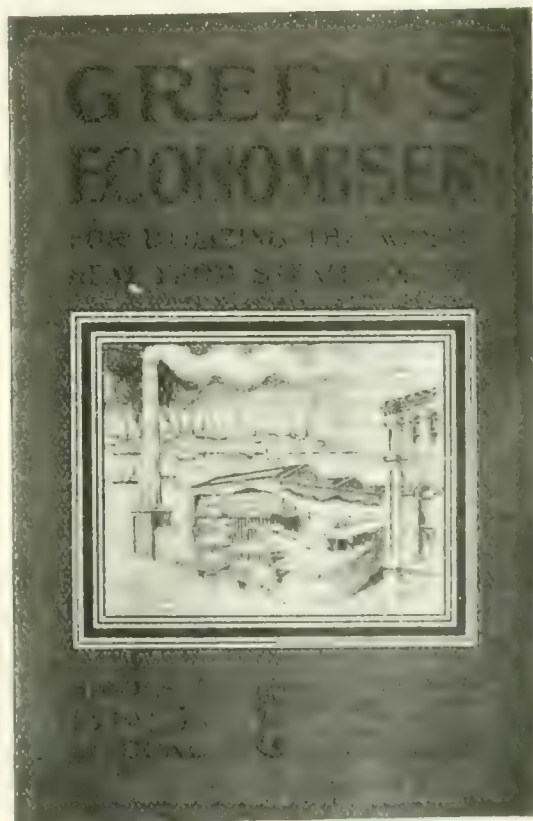
CATALOGUE COVER DESIGN.

We illustrate here with a striking cover which is used by Messrs. E. Green and Son, Ltd., for their latest descriptive pamphlet on the subject of "Green's Economiser." The design tells its own story in a forcible way. We learn, at a glance, enough about the economiser to invite an inspection of the pamphlet and interest is further stimulated by the announcement in the lower left-hand corner which calls attention to a saving of from 15 to 25 per cent. on fuel. The design is chiefly black on green, the centre panel being rendered in grey.

Up to the 30th ending September, and the total number of visitors to the Liege Exhibition from April 27th last was 3,755,000, the total amount of cash received by the exhibition authorities for admissions and season tickets being 2,728,800 francs.

Following the annual general meeting of Rugby Engineering Society on Thursday, Mr. J. Sugden, member, delivered a lecture entitled "Protection from Electric Shock," with practical demonstration of the necessary treatment after a shock.

Messrs. Cundall, Sons and Co., Ltd., engineers and iron founders of Airedale Ironworks, Shipley, advise us that they have taken over the business of the late firm of R. Cundall and Son, Ltd. Their telephone number is 4 Shipley; telegrams are addressed "Cundall, Shipley." The London office of the firm is at 20 and 22, St. Bride Street.



COVER FOR "GREEN'S ECONOMISER"

FLYWHEEL EXPLOSIONS.

By W. H. BOEHME, M.E.

(Continued from page 76.)

UNFORTUNATELY when an engine starts before the men in charge of machines in the mill shut them down, and the decrease in load causes a further increase in speed until the engine, entirely freed of its load, runs away and disrupts itself by centrifugal force.

The stress in the rim of a flywheel, due to centrifugal force, will be better understood by a consideration of the formula

$$WV^2$$

$$I = \frac{2.66}{E}$$

Type of Wheels and maximum obtainable efficiency of rim joint.				
No. joint. 1.00	Flange joint. .75	Key joint. .50	Lock joint. .60	
				
Revol. Per Min.	R. P. M.	R. P. M.	R. P. M.	R. P. M.
1.	1910	955	1350	1480
2.	955	478	675	740
3.	637	318	450	493
4.	478	239	338	370
5.	382	191	270	296
6.	318	159	225	247
7.	273	136	193	212
8.	239	119	169	185
9.	212	106	150	164
10.	191	96	135	148
11.	174	87	123	135
12.	159	80	113	124
13.	147	73	104	114
14.	136	68	96	106
15.	128	64	90	99
16.	120	60	84	92
17.	113	56	79	87
18.	106	53	75	82
19.	100	50	71	78
20.	95	48	68	74
21.	91	46	65	70
22.	87	44	62	67
23.	84	42	59	64
24.	80	40	56	62
25.	76	38	54	59
26.	74	37	52	57
27.	71	35	50	55
28.	68	34	48	53
29.	66	33	47	51
30.	64	32	45	49

If the revolutions given in the table be increased 20 per cent, the margin of safety on speed will be reduced to *two and one half*; if the revolutions be increased 40 per cent, the margin of safety will be reduced to *two*.

The stress due to centrifugal force, in the rim of a fly wheel made of any material of known strength, and also the bursting speed may be obtained from the following formula:

$$F = \frac{W \times V^2}{2.66}$$

$$B = 1.63 \times \sqrt{\frac{S \times E}{W}}$$

In the above formula, F the stress in pounds per square inch, when the rim speed is V feet per second, B the bursting speed in feet per second at which disruption will occur, S the tensile strength of the material in pounds per square inch, W its weight in pounds per cubic inch and E the efficiency of the rim joint.

from which the stress tending to burst the rim asunder may be obtained for a wheel made of any material and running at any speed.

Stated in words, the formula means that if we multiply the square of the velocity of the rim in feet per second by the weight in pounds of one cubic inch of the material in the wheel, and then divide the product by 2.66, the result will be the force in pounds per square inch tending to burst the wheel.

As a cubic inch of cast iron weighs about .26 of a pound, this gives for cast-iron wheels

$$V^2$$

$$I = \frac{1}{10} \text{ approximately.}$$

That is, the stress tending to burst the rim of a cast-iron wheel is one-tenth of the square of the velocity of the rim in feet per second.

From either of these formulae it is seen that the stress in the rim of a wheel increases with the square of the speed, or, to put it another way, the margin of safety on speed is always the square root of the factor of safety on strength.

If the speed be tripled, for example, the stress in the rim becomes nine times as great as before; that is, with a factor of safety of 9 on strength, there is a margin of safety of only 3 on speed. It will be understood from this that the stress increases enormously for even a slight increase in speed.

STRESSES IN FLYWHEELS AND BOILERS COMPARED.

Comparing flywheels with boilers, it will be observed that while steam is always the primary cause of boiler explosions, speed is usually the primary cause of flywheel explosions. It would seem, therefore, almost as proper to speak of high "speed pressure" as to speak of high "steam pressure."

As a matter of fact, the influence of speed on flywheels is much the same as the influence of steam on boilers. Both produce radial forces whose resultants exert a tensile stress in the rim of the flywheels, or in the shell of the boiler, as the case may be.

In the case of boilers, steam exerts the radial force, acting on the shell of the boiler, and whenever the steam pressure becomes sufficient, the resultant stress bursts the boiler with great violence. In the case of flywheels, speed exerts the radial (centrifugal)

force acting on the rim of the flywheel, and whenever the speed becomes sufficient, the resultant stress bursts the flywheel with great violence.

The term "explosion" may, therefore, be properly applied to either case.

While the influence of speed on flywheels is, as has been shown, much the same as that of steam on boilers, it should be borne in mind that when changes of speed and pressure occur, the stresses produced in each case follow entirely different laws.

In the case of boilers, the stress in the shell increases proportionally with the steam pressure. Doubling the steam pressure, for example, doubles the tensile stress acting on each square inch of the shell. In the case of flywheels, the stress in the rim increases with the square of the speed. Doubling the speed, for example, quadruples the tensile stress acting on each square inch of the rim.

In the case of boilers any increase in the thickness of the shell will allow a proportionate increase in the steam pressure that may be carried. If, for example, we should double the shell-thickness, we could double the steam pressure. In the case of flywheels, increasing the thickness of the rim does not increase the allowable speed at which it may be run. The reason for this is that any weight added to increase the thickness of the rim increases the centrifugal force in exactly the same ratio.

It will be understood from the foregoing that while engine-pulley or flywheel can be designed to successfully resist the torsional stress due to any load required of the engine, there is no possible way to overcome the centrifugal stress due to speed.

CALCULATION OF SAFE RIM SPEEDS

For a given material there is a definite speed at which disruption occurs, regardless of the amount of material used. This is not an uncertain theory, but a mathematical truth easily demonstrated, and is expressed by the formula

$$V = 1.63 \sqrt{\frac{S}{W}}$$

in which V is the velocity of the rim of the wheel in feet per second at which disruption will occur, W the weight of a cubic inch of the material used, S the tensile strength of one square inch of the material, and E the efficiency of the rim joint ($E = 1$ for wheels without rim joints).

Stated in words, the formula means that if we multiply the tensile strength of the material by the efficiency of the rim joint, divide the product by the weight of one cubic inch of the material, extract the square root of the quotient and then multiply

this by 1.63, the result will be the rim speed in feet per second at which disruption will occur.

If, instead of the ultimate strength of the material, we take its safe strength, the result will be the rim speed in feet per second at which the wheel may be run with safety; the supposition being, however, that the rim is made in one piece, is of homogeneous material, and is free from shrinkage strains.

Applying the formula to determine the safe rim speed for cast-iron wheels made in one piece, we would assume that, if the ultimate strength of small test bars were 20,000 lb. per square inch, we could depend upon having 10,000 lb. in large castings.

Using a factor of safety of 10 on this would give 1,000 lb. per square inch as the safe strength of this material. The weight of a cubic inch of cast iron is approximately .26 of a pound, so that for cast-iron wheels we have

$$V = 1.63 \sqrt{\frac{S}{W}} = 1.63 \sqrt{\frac{1000}{.26}} = 100 \text{ ft. per second,}$$

so that perfectly-sound cast iron wheels made in one piece and free from shrinkage strains may be run with ample safety at a rim speed of 100 ft. per second, which corresponds to about 1.15 miles per minute.

TYPES OF WHEELS

Small cast-iron wheels are made in one piece. Large wheels are made in halves or sections to facilitate handling and transportation. It is common practice to make all engine wheels up to 8 ft. in diameter in one piece; those between 8 and 16 ft. in halves; and those over 16 ft. in sections, the number of sections being usually equal to the number of arms in the wheel. Wheels are not often made larger than 30 ft. in diameter, although 30 ft. is, itself, a size frequently encountered.

Wheels smaller than 8 ft. are frequently made in halves, either to avoid shrinkage strains or to enable them to be placed on their shafts without first having to take off other wheels. Frequently the hub only is split to obviate shrinkage strains.

This difficulty of shrinkage strains is a serious problem, and formerly led to the expediency of making the arms of small wheels in fantastic curves, often shaped like the letter "S." Shrinkage strains are produced by the unequal cooling of the arms and rim when the wheel is cast. If the mass of metal in the arm, for example, is proportionately greater than that in the rim—a frequent case with thin-rimmed wheels—the inner portion of the arm, as it cools first, is pulled upon by the more slowly cooling arms, thus producing a shrinkage strain, which, if continued, will eventually lead to the failure of the wheel.

The effect of the irregular cooling is to apply to cast enormous shrinkage strains in the wheels, but also to leave the metal at the juncture between arms and rim in a dangerously porous or honeycombed condition. The porous condition of the metal is caused by the tendency of the rim in cooling to pull away from the rim while the metal is in a plastic or half-molten state.

RIM JOINTS.

Rim joints are a constant source of danger and should receive careful consideration. Perhaps the importance of looking to the rim joint will be better appreciated when it is remembered that the usual bolted and flanged rim joints, located between the arms of sectional belt wheels, average a strength of only 20 per cent. of the solid rim, and that it is not possible to design a joint of this kind having a strength greater than 25 per cent. of the solid rim. By placing the joints in such wheels at the ends of the arms, instead of between them, an efficiency of 50 per cent. of the strength of the rim may be obtained. The reason for this is that the centrifugal force of the heavy flanges and bolts is directly sustained by the arms, instead of being left free to act as a bending force on the rim.

In heavy, thick-rimmed balance wheels, where steel links are shrunk on to reinforce the joint, an efficiency of 60 per cent. is possible, but this construction cannot be applied to belt wheels having thin rims.

Assuming rim joints designed for the greatest possible strength and using the formula previously given, we have computed, the allowable number of revolutions per minute for the several types and sizes of cast-iron flywheels in current use. These are given in the table on page 77.

In preparing this table a margin of safety of 3 on speed has been allowed, so that if the revolutions there given be multiplied by 3, the result will be the number of revolutions at which disruption will occur.

Flywheels are subjected to a great variety of strains, the greatest of which is that due to centrifugal force. It is this strain that causes the majority of flywheel wrecks. The rim velocity at which centrifugal force becomes sufficient to burst a wheel made of any given material is, as has been previously stated, expressed by the formula.

$$V = 103 \sqrt{\frac{SE}{W}}$$

An inspection of this formula shows that the bursting speed is proportional to $\sqrt{SE}$ and this means that the material which has the greatest strength for a given weight will stand the highest speed before going to

pieces. Since wood possesses this quality, it is in the above respect a better material for flywheels than cast iron.

In comparing wheels having wood rims, however, with those having cast-iron rims, it should be remembered that the wooden rims are built up of segments fastened together. These segments are sawn so as to obtain as much of the straight grain of the wood as possible, but the full tensile strength of the wood is never obtained. Partly for this reason and partly for others, a factor of safety of 20 is used for wood, where 10 would be used for cast iron. Twenty in this case is, however, only an apparent factor of safety, because a part of the tensile strength lost in sawing is included in this, making the real factor of safety, of course, less than 20.

Again, the wooden segments are put together to break joints so that the strength is further reduced one-half. This may be helped somewhat by arranging the segments so that only every third or fourth joint comes in line, instead of every other joint, but if this is carried too far, the contact surface on the sides becomes less and weakens the shearing strength of the segments.

Applying our formula to hard maple having a tensile strength of 10,500 lb. per square inch and weighing 0.283 of a pound per cubic inch, we have, using a factor of safety of 20, and remembering that the strength is reduced by one-half.

$$V = 103 \sqrt{\frac{SE}{W}} = 103 \sqrt{\frac{5250 \times 5}{0.283}} = 154 \text{ ft. per sec.}$$

so that a well made maple wheel may be run with perfect safety at a rim speed of 154 ft. per second, which corresponds to 175 miles per minute. Or comparing two wheels of the same diameter, one of cast iron and the other of maple, the number of revolutions per minute for the maple wheel may be 54 per cent. greater than for the cast iron wheel. One hundred and fifty-four feet per second would not, however, be a safe rim speed for wooden wheels if made in halves or sections, on account of the weakness of rim joints.

WOODEN FLYWHEELS

After a disastrous flywheel wreck at the Amoskeag mills, Charles H. Manning, M.E., superintendent of the mill, designed and had constructed a large wooden flywheel. This wheel is 30 ft. in diameter and 9 ft. face. The rim is 12 in. thick and is built up of 44 courses of ash plank. The segments break joints and are glued and bolted together. There are two hubs and two sets of arms, twelve in each set and all of cast iron. The wheel weighs about 104,000 lb., and was tested to a speed of 76 r.p.m., corresponding to a rim speed of 136 miles per minute.

Since the construction of this wheel many large flywheels have been built of wood. They are satisfactory in service, and several large manufacturing concerns have made a specialty of wood-wheel construction.

SUPERIORITY OF STEEL WHEELS

Bringing into service again our formula for the bursting speed of flywheels, we see at once that steel is a superior material for the construction of wheels of large size. Unfortunately, the extreme cost of such wheels precludes their general adoption. Notwithstanding this, steel as a material has plenty of advocates, some engineers going so far as to say that it is the only fit material for large flywheels of high speed and high power.

In comparing steel wheels with wheels made of other materials it should be remembered that no wheel is ever stronger than its weakest section. As the rims of these wheels are built of plates cut into segments and riveted together, the weakest section is not necessarily at a rim joint, although usually so.

Assuming an efficiency of 50 per cent. in the rim joint, and that no section of the rim has a net area less than 50 per cent. of the gross area of the cross-section, and using a factor of safety of 10, steel having a tensile strength of 60,000 lb. per square inch, would allow a safe rim speed of

$$V = 17.3 \sqrt{\frac{S \cdot F}{W}} = \sqrt{\frac{60,000 \times 50}{2.5}} = 158.11 \text{ ft. per second,}$$

corresponding to 17.9 miles per minute. Thus steel wheels will stand a speed of 90 per cent. greater than cast-iron wheels.

THREE TYPES OF STEEL WHEELS.

Steel wheels may be divided into three distinct types, (1) those having centre and rim built up entirely of steel plates, (2) those having cast-iron centre with steel rim, and (3) those having cast-steel centre and plate-steel rim.

An interesting steel wheel of novel construction was recently designed by Mr. Manning for the Amoskeag Manufacturing Company. The wheel has a cast-iron centre and steel rim. The rim, however, is not built up of segments, but is made of rings or hoops, one within the other, all securely riveted together. In describing this wheel, Mr. Manning says it is stronger than steel wheels made of segmental plates and is also cheaper because the material is not wasted in cutting. The wheel is 15 ft. 3 in. diameter, and 36 in. face.

Steel wheels for extreme speeds have been constructed by winding steel discs with wire. Such a wheel is in operation in a rolling mill at Ladore, Wales, using the Mannesman process of rolling tubing from the

solid bar. As an immense amount of power is required for only a short interval, the wheel is subjected to heavy shocks as well as to high speed.

In constructing this wheel, two steel discs 20 ft. in diameter were bolted to a cast-iron hub. The outer edges of the discs form a groove into which 70 tons of No. 5 steel wire are wound under a tension of 50 lb. This wheel is operated at 240 r.p.m., which corresponds to a rim speed of 2.85 miles per minute. The wheel replaced by this one, and which was made of cast iron in the usual manner, broke at a rim speed of 1.42 miles per minute.

THE ASSOCIATED PORTLAND CEMENT MANUFACTURERS.

NEWS ITEMS.

The British Fire Prevention Committee are undertaking a series of fire and water tests with different aggregates of concrete, with a view of comparing the fire resistance of different aggregates when subjected to fire and water under absolutely identical conditions. The aggregates will be those in common building practice, the cement used being in accordance with the standards of December, 1904, known as "Ferrocrete" cement, provided by the Associated Portland Cement Manufacturers.

The Wellman-Seaver-Morgan Company, of Cleveland, Ohio, advise us that they have completed arrangements for the formation of a separate English company, to take over their patents and entire business in Europe and the British Empire. The new company will be entitled "The Wellman-Seaver-Morgan Company, Ltd.," with offices at 47, Victoria-street, London, S.W. Mr. S. T. Wellman has consented to become chairman, and Mr. Benjamin W. Head will be managing director.

Some notable ropes turned out by Messrs. W. Cooke and Co., Tinsley, included an incline hauling rope, 6,560 yards long, by 1½ in. diameter, of their improved plough steel quality, galvanised, which weighed over 32 tons. Another rope of the same quality, which was 4,000 yards long and 1½ in. diameter, was supplied to Sir Alfred Hickman's Haunchwood Colliery. It was put to work in 1897, and lasted seven years and two months, and has drawn over 1,000,000 tons of coal.

Mr. Hugh Blair, of Glasgow, has been elected chairman of the Glasgow Harbour Trustees, and is one of the most prominent ship-owners in Scotland, and was well known for the Glasgow Harbour Trust, which was founded in 1800, and has since that time been a leading concern in the shipping trade between Leith and America.

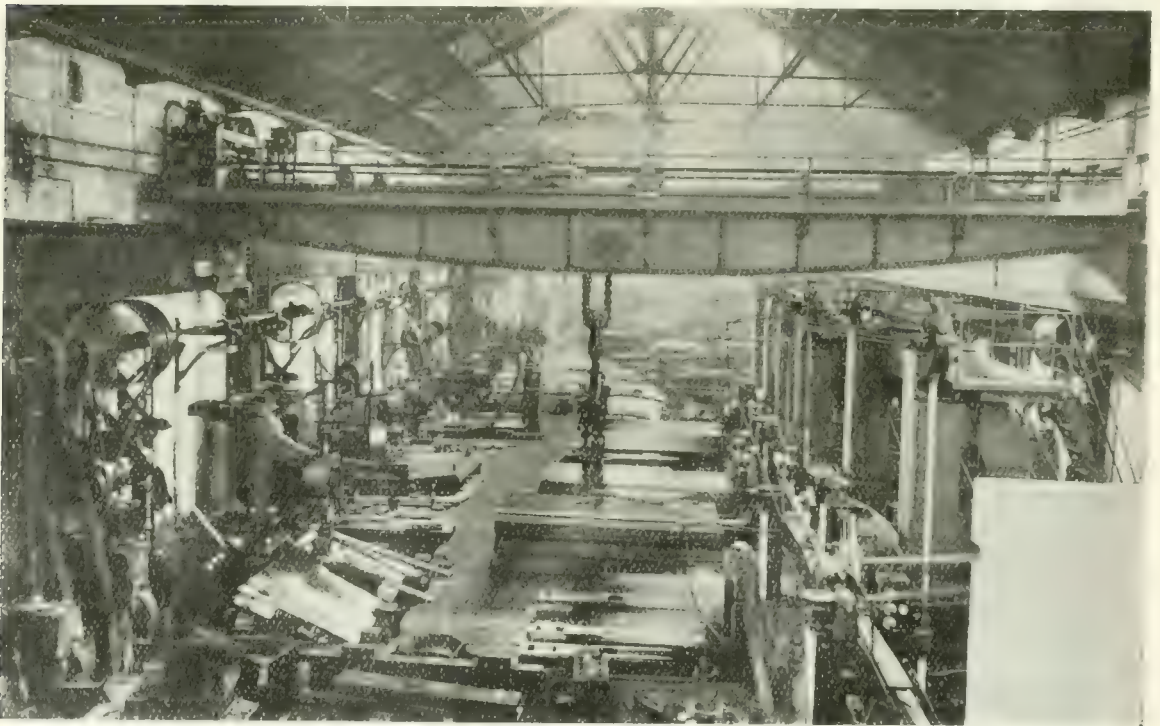
THE ATLAS WORKS, SHEFFIELD.

THE ATLAS WORKS at Sheffield, which were founded a little over fifty years ago, are world-famous in the history of armour plate and steel manufacture, and the growth and development of this huge combination of engineering, shipbuilding and mining is an example of sound policy and resource, which proved very edifying to the members of the Iron and Steel Institute last week.

The concern had its beginning in the business carried on by Mr. John Brown at Orchard Street and Furnival Street, in Sheffield, in a comparatively small way, but it was not until 1854 that Mr. Brown took the tide upon the flood which led to fortune. At that time he acquired what was known as the Queen's Steel Works, previously carried on by Messrs. Armitage, Frankish and Barker. He reorganised the establishment, re-named it the

Atlas Works, and secured as partners Mr. John D. Ellis and Mr. William Bragge. In the early years of the history of the works, all three of these gentlemen directed their great skill and energy to the development of the business, and as a recognition of the part which the company had played in the manufacture of armour, her late Majesty Queen Victoria conferred upon Mr. Brown, as head of the establishment, the dignity of knighthood in 1867.

A few facts will serve to indicate generally what these coadjutors have done for the business. The Atlas Works, when they became the property of the three partners, covered three acres; now the area is 36 acres at Sheffield, 78 acres at Clydebank, and about 150 acres of surface and 7,000 acres below ground at Rotherham Collieries, besides which the company are owners or part owners of other industrial properties of considerable magnitude.



ARMOUR PLATE PLANING SHOP AT THE ATLAS WORKS

In 1854, the works of the company were valued at £14,050; to-day they are worth 2½ millions sterling.

EQUIPMENT OF THE WORKS.

The greater part of the 36 acres within the boundaries of the Atlas Works are covered with buildings. There are in the works 43 furnaces for reducing the iron, and other metals used in the various processes of manufacture, which necessitate the use of 400 tons of coal and 100 tons of coke each day of the year. There are ten hydraulic presses including one of 10,000 tons power, and 33 steam hammers to work the hot ingots, some of them 80 tons in weight, down to the approximate form of the finished product. For manipulating heavy weights, there are 94 travelling cranes, two of them having a capacity of 150 tons, one of 100 tons, and most of the others of 50 to 60 tons; in addition there are 14 locomotives in the works, for conveying the products from one shop to another on the many miles of railway running like a network through the establishment. There are 307 machine tools, many of them of great power, for planing, turning, boring and otherwise shaping the forgings and castings to finished dimensions. They are driven by prime movers developing an aggregate of 12,000 h.p., which is transmitted to the tools largely through the medium of electricity.

AN OUTPUT OF 100,000 TONS.

Although the area occupied by the Atlas Works at Sheffield has increased twelvefold since they were first commenced, the actual turnover of the company has multiplied one hundredfold, from £30,000 to £3,000,000 sterling per annum, and this fact in itself affords a clear evidence of the beneficial influence of modern mechanical methods. The output fifty years ago probably did not exceed 5,000 tons per annum, whereas to-day it is close upon 100,000 tons. The 20,000 workers employed in the works of the company earn in wages about £1,250,000 sterling per annum.

BESSEMER STEEL PRODUCTION.

The Atlas Works were the first to produce steel by the Bessemer process, apart from the establishment of the inventor. It was in 1858 that Sir Henry, then Mr. Bessemer, found in the partners of the Atlas Works that outside encouragement which subsequently helped greatly to overthrow the strong wall of prejudice against his process of manufacturing steel in converters. It is true that Sir John Brown was not at first enamoured of the system, but the success in Bessemer's own establishment which adjoined the Atlas Works, and in which Bessemer steel was made at a cost of £20 per ton, was convincing, and an arrangement was entered into under which Mr. Brown and Mr. Ellis both became important factors in the ultimate commercial success of the new process. The first order which the firm secured for Bessemer steel rails came from abroad. The difficulty of obtaining a trial in this country is indicated by the fact that a twenty years' guarantee had to be given before the clients would accept the new metal.

The firm too, were among the first to manufacture steel plates for shipbuilding, Bessemer steel being first used for this purpose about 1856, although the introduction of the open-hearth furnace ten years later brought about a change, and Siemens furnaces were laid down to meet the growing demand. For the rolling of Bessemer steel for tyres, plates and angles, and other purposes, mills were put down about 1858.

ARMOUR PLATE MANUFACTURE

But a greater step forward, and one of national significance, was the commencement of the manufacture of armour plates, and that by an entirely new process. The first experiments were made at the end of 1850 and instead of adopting the practice of hammering the metal in the plate form, as was in vogue abroad for the first armour made, the Atlas Works put down a mill for rolling broad bars to the required width, and these

were piled upon each other successively and the resulting piles re-rolled and welded together in sufficient numbers to make the desired thickness of armour plate. The first mill had rolls 24 in. in diameter and was actuated by two beam engines of 300 h.p. Whitworth and other gunmakers, however, were working diligently to make the attack on the plates more powerful, and the demand of the naval architect was then for increased thickness. To meet this, there was laid down at the Atlas Works in 1863, a mill with 32 in. rolls driven by powerful engines, and an entirely new shop was erected and equipped with immense tools for machining the heaviest of armour plates.

The many changes necessitated by the introduction of the Bessemer system in 1858, with its converters, new forge and rolling mills, the laying down of immense armour plates, rolling mills and machinery, and other improvements, suggested to the management in 1864 the expediency of converting the co-partnership into a limited liability company with a capital of one million sterling. Sir John Brown was the first chairman, but six years later he retired and was succeeded by Mr. John D. Ellis, who still continues in the position of chairman, with Mr. Charles E. Ellis as managing director. The firm at this time sought to secure for itself a large measure of independence by the purchase of iron ore mines in Spain, Lincolnshire and Northamptonshire, and also of valuable coal mines in Rotherham, an arrangement which has proved eminently successful. At the same time blast furnaces were erected at the Atlas Works, so that the company were able to convert the raw material from its natural state into the finished product: armour plates, forgings, shipbuilding materials, railway plant of all descriptions, etc. The last-named manufacture had enormously increased, and at this time the works produced vast quantities of steel rails, while their weldless steel

tyres, introduced in 1865, were quickly appreciated.

RECENT DEVELOPMENTS

During the past four or five years the company have, at enormous cost, almost doubled their producing capacity. Large armour-plate machine shops have been added and electric power adopted for driving the tools. Generally, the capacity of the works for supplying armour has been increased to about 10,000 per annum. During the last twelve years armour plates have been constructed for over fifty British ships, and for naval ships for Japan, Russia, Spain, Norway, Sweden and Holland. The machine shops for forgings, etc., are equipped with powerful and modern machinery, including lathes up to 80 ft. in length by 60 in. centres, and boring machines to cut a hole 15 in. in diameter out of the solid at 1 in. advance per hour. With this plate the heaviest shaftings and forgings have been produced not only for British but for many foreign warships and merchantmen.

THE COMPANY'S CLYDEBANK WORKS.

The fact that the company make many of the requisites for warships and merchant steamers—armour plates, boiler material, flues, tubes, engine shafting and forgings generally—prompted the management to acquire the Clydebank Shipbuilding and Marine Engineering Works, which, during their fifty years of previous existence, had acquired a high reputation, alike for warships, Atlantic "greyhounds," and merchantmen of every type. The works were well equipped, new tools having been added from time to time as the ambition of the shipowner and naval designer called for larger vessels and higher speed; but since taking over the establishment in 1899, the company have greatly increased the producing capacity, constructing new shops, and providing modern tools to improve and cheapen the production. The Clydebank yard has seven shipbuilding berths, ranging up to 900 ft. in length, while foundations have been provided to permit

of the construction of vessels whose launching weight may be 9,000 tons within a limited area. In addition, there are several berths for smaller craft. Practically, everything is done within the establishment for the complete equipment of these ships, and the average annual output of new machinery over a period of years has been in excess of 60,000 i.h.p.

In 1903, an arrangement was entered into whereby the Norfolk Works, at Sheffield, of Messrs. Thomas Firth and Sons, became practically, although not nominally, allied with John Brown and Co., Ltd., so that the latter company thus considerably increased its resources for the supply of ordnance, projectiles, steel castings, forgings, etc.

The Atlas Works possess extensive laboratories, where all material, as it arrives in the raw state, or leaves in a complete form, is subject to examination; samples being taken for chemical analysis and mechanical tests.

The works generally are lighted by arc lamps, running four in series, and the offices by incandescent lamps taking the full pressure of 220 volts.

The manufactures of this mammoth undertaking include armour plates, marine and other engines, crank shafts, shaftings of all kinds, gun and other forgings, projectiles of all types, patent ribbed boiler flues, patent ribbed boiler tubes. Ellis and Eaves' induced draught apparatus, steel castings of all descriptions, railway tyres, axles, springs, buffers, etc., foundry and forge pig iron, etc., etc. In addition, there may be mentioned the steam coal, gas and other coals from the company's Rotherham Collieries, with a reputation equal to that of the foregoing manufactures. The collieries give the huge output of 1,500,000 tons per annum.

Everything possible is done for the comfort and convenience of the workmen.



THE INTERIOR OF THE ATLAS WORKS, SHEFFIELD.

THE PHŒNIX SPECIAL STEEL WORKS OF MESSRS. STEEL, PEECH AND TOZER, LTD.

These works, visited by the Iron and Steel Institute last week, were acquired in 1875 by Messrs. Steel, Tozer and Hampton, Ltd., from the liquidators of the Phœnix Bessemer Steel Company, Ltd., and the change to the present name of Steel, Peech and Tozer, Ltd. took place in the year 1883.

Originally the manufacture was confined to articles of Bessemer steel, of which railway rails formed the principal part, but in the course of time considerable developments took place. Three Siemens-Martin furnaces were added to the already existing Bessemer plant, and the firm commenced supplying higher class materials of special qualities for all requirements.

The works are specially adapted for the manufacture of railway material, such as tyres, axles, springs and spring steel for locomotives, carriages and wagons, of which they supply very large quantities to the leading railway companies. The production of railway and tramway rails forms a good portion of the firm's output, in addition to which girders, forgings, blooms and rolled bars of various sections are made in considerable quantities.

At the present time the firm are erecting additional Siemens plant. The concern is a private limited company, and the shareholders and management are confined to the three families named in the title of the firm. About 1,500 hands find employment at these works. The situation of the works is good, the river Don passing alongside the premises, while the Great Central and Midland Railway Companies' main lines are in close proximity.

BESSEMER PLANT.

The Bessemer plant comprises five cupolas for melting pig iron, spiegeleisen, etc., also two 15-ton converters, along with the necessary blowing engines, cranes, etc. The output of the shop is about 200 tons of ingots per turn of twelve hours, and the plant is worked night and day.

The cogging mill consists of powerful reversing engines coupled to 36-in. mill, for reducing the ingots to suitable dimensions in readiness for the finishing mill, the requisite furnaces and live-roller gear.

The rail mill has also reversing engines, rolls for railway and tramway rails, girders, blooms and billets, along with the necessary straightening and drilling machines, electric cranes, motors, etc. In this department 300 tons is a fair average production for twelve hours' work.

HAMMER SHOP.

The hammer shop contains four steam hammers, varying from 7 tons to 30 cwt. The largest hammer is engaged on crank-axles, piston-rods, connecting-rods, and general forgings and blooms, whilst the other hammers make wagon and carriage axles and smaller forgings.

TYRE DEPARTMENT.

In the tyre department there are punching and becking hammers, rolling mill for finishing the tyres, along with the requisite boilers and engines for working a complete modern tyre plant. Tyres are produced in various sizes and weights, varying from 1½ cwt to 14 cwt. each, according to requirements.

SIEMENS' PLANT.

The Siemens Martin steel plant consists of three 35-ton furnaces with the needful gas producers, electric travelling cranes, casting pits, etc. Ingots are cast in various shapes, such as tyre ingots, square and octagonal ingots, as may be required.

MERCHANT MILLS DEPARTMENT.

There are four trains of rolls in the merchant mills department, together with the necessary engines, boilers, shearing machines, etc. Spring steel in a considerable range of sizes is produced in large quantities, both for use in the firm's own spring department and for sale to customers: also rounds, flats and bars of various sections.

SPRING MANUFACTURE

The spring department is well equipped for the manufacture of laminated springs for locomotives, carriages and wagons. It contains sundry hammers for forging the spring hoops, etc., also numerous furnaces for heating the plates, together with all the necessary machines for drilling and finishing springs complete. The tools are all driven by electric motors.

OTHER DEPARTMENTS.

The fitting and turning shops are fitted up with planing, shaping, turning, drilling, etc., machines, lathes and cranes, all electrically driven, together with all the incidental outfit necessary in a large turning shop. Loco crank-axles and forgings in the rough stage from the forge are finished in this department, and supplied in the finished state when so required.

The foundry, pattern shop, testing department, smithies, etc., were also thrown open for the inspection of visitors.

THE NORFOLK WORKS OF MESSRS. THOMAS FIRTH AND SONS, LTD.

Prominent among the excellent programme of visits to works was the inspection on the Thursday of the Norfolk Works of Messrs. Thomas Firth and Sons, Ltd. This firm, as many of our readers are aware, is among the largest contractors for railway material and manufacturers of crucible cast-steel forgings, castings, and projectiles.

The latest description of the works, which cover an extensive area, appears to have been given a few months ago in the Railway Magazine, from which we cull the following particulars. The workshops give employment to some 2,000 men. It requires thirty boilers, 30 ft. long, and 7 to 8 ft. in diameter to generate the steam power for the 3,000 i.h.p. engines, which supply the motive power for an annual capacity of about 5,000 tons crucible and 30,000 tons of Siemens-Martin steel. In the crucible furnaces alone 200 men are employed in the manufacture of steel which is largely used for fine tools.

In the moulding shop a glimpse was caught of the initial stage in the process of wheel centres for locomotives. These castings, however, were small compared with a 20 ft. diameter mill-wheel, which had a depth of 17 in., and a 4 in. pitch. This ponderous wheel was to be cast in one piece, to be cut up afterwards in segments, and its teeth to be milled to prevent vibration. Alongside this was a helical spur rim, 11 ft. 7 in. in diameter, and weighing fully fifteen tons.

Passing from the moulding shop to the Siemens furnaces, where steel for ordnance, shafting cranks, tyres, etc., is manufactured, it was pointed out that most forgings of any size are made by this process, unless otherwise specified. In this department there are four furnaces, ranging from ten tons to forty-five tons, with which ingots up to one hundred tons weight can be produced.

Crossing to the forge, a busy gang of men was engaged in hammering out steel to sizes suitable for piston rods, slide bars, crank pins, crossheads, outside cranks, crank arms, and other small parts necessary in the building of a locomotive.

At the West Gun Works crank axles and tyres, in the rough and finished state for locomotives, are furnished for the various great railway companies.

This department is responsible for the manufacture of mounted wheels and axles for carriages and wagons. Locomotive tyres up to 36 in. in diameter are produced.

At the East Gun Works the speciality is in making cast-steel wheel centres for locomotives and tenders—a speciality of this department.

Messrs. Thomas Firth and Sons hold the sole license for the manufacture of Russell's Patent Turtle Back Ramp, and the Feeney Patent Corrugated Turtle Back Ramp.

The plant includes huge hydraulic forging presses, of 2,000 and 3,000 tons respectively, which are quite capable of dealing with the largest forgings likely to be required, and a hardening tank, which has a depth of 75 ft. and holds 15,000 gallons of oil. Among the specialities of the firm are their "Speedicut" high-speed steel and twist drills, which are capable of taking off heavy cuts at very great speeds. Projectiles of all descriptions are another speciality of the company, which is one of our own Government's largest suppliers.

NEWS ITEMS.

"Gas and Oil Power" is the title of a new illustrated monthly review to be issued during the present month.

Mr. C. B. Kingston, M.Inst.M.M., of Messrs. Pearse, Kingston and Browne, left London on September 9th for South Africa.

It is reported that a group of British capitalists have agreed to advance a sum of £1,000,000, to the Kansai Railway, Japan.

Mr. James Swinburne lectures to-night at the Electrical Exhibition on the subject of "Domestic Lighting," this being one of the series of lectures arranged by the Institution of Electrical Engineers.

The death of Sir William Shelford, K.C.M.G., which took place on Tuesday, removes from the engineering world a strong personality who has left the hall-mark of his remarkable ability over a very considerable portion of the earth. Born in 1834 he was educated at Marlborough College, and afterwards underwent a term of apprenticeship in engineering with the late Mr. W. Having served under Sir John Fowler and Sir Benjamin Baker in 1865 he set up in his own right at Westminster as a consulting engineer. To a great extent Sir William specialised on river and estuary work, but his railway practice was also extensive. He was mainly responsible for the construction of the West African Government Railway, and his work in connection with the Hull and Barnsley railway will long be remembered.

ELECTRICAL EXHIBITION AT OLYMPIA.

(Continued from page 71.)

GENERAL ELECTRIC COMPANY, LTD.

The General Electric Company's stand at Olympia Exhibition is divided up into various sections, each section representing one of the many departments which are embodied in the concern.

A feature of the telephone exhibit is the telephone K.25, to which many improvements have recently been added.

The display in the Engineering Supplies Department consists of an assortment of Freezor fans for continuous current and alternating current in all shapes and sizes, small direct-current motors, motor starters, transformers, liquid resistances, theatre lighting accessories, traction supplies, etc., etc. Visitors should inspect the company's set of motor starting and controlling apparatus, several of which are of new design.

There is also a good show of electric heating and cooking apparatus, and some new types are exhibited. A number of "Witton" small motors, "Witton" continuous-current motors, and "Witton" three-phase motors also attract attention, and this is a field which has been assiduously cultivated by the company.

The Conduit Department displays a very representative collection of their various specialities, including Union Pipe steel Insulated Conduits. The method adopted in the manufacture of this conduit is entirely different to that previously employed, as the tubing is drawn on to the insulating lining, instead of the insulation being expanded into the tube.

In connection with the conduit exhibit, attention may be called to the method of fixing conduit and the like to walls, etc., by means of the "Union" improved patent plugs; these being the very latest development in the ready-made plug idea.

A new adaptation of the 25-ampere "Midget" wall plug to conduit purposes is shown in the iron-cased watertight multiple 'way box with watertight lid. Various designs of junction boxes, such as have recently been supplied to H.M. Government for dockyard wiring, are also on view. The display made by the company in this and other departments is quite noteworthy.

LANCASHIRE DYNAMO AND MOTOR COMPANY.

The automatic reversible booster exhibited is similar to that shown at the Tramways Exhibition, and is by way of becoming an old friend. Its advantages may be thus summarised. The laminated fields of the booster give very quick reversal, the booster is easily paralleled, and it is possible to arrange, by suitable adjustment of the field resistances, either for constant load on the generator, or for a load on the generator varying within certain limits. Further, the alteration of the dynamo shunt regulator does not

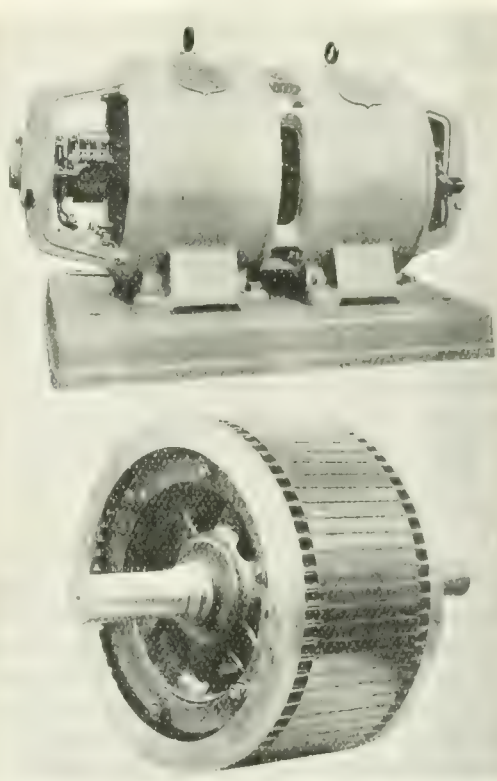


FIG. 1. A TURNBULL AND MCLEOD BOOSTER BY THE LANCASHIRE DYNAMO AND MOTOR COMPANY.

necessitate any alteration in the booster field regulator, as it is self-regulating. There is said to be no hunting, and charge and discharge currents can be adjusted to suit the particular conditions of the generating station.

The company are also showing induction motors of 10 and 20 h.p., all wound for 60 period, speed of 1,150 revolutions, of standard short circuited rotor type.

Attention may be directed to the centring device in the endplate, by means of which, should the bearings wear, the air pump may be adjusted from the outside of the motor. Visitors will notice amongst the other exhibits some of the company's standard continuous current machines. There is also shown a balancer set, consisting of two standard machines coupled back to back, this set having two bearings only. The construction of these balancer sets is very strong, the armatures being built up on a cast iron sleeve, which extends from the bearing at one end and is formed into a large coupling at the other end. This half coupling is bolted to a corresponding one on the other machine, and is claimed to give great rigidity. This machine is held to be more efficient than the three bearing machines, as the third bearing is frequently a source of trouble.



FIG. 3. SIMPLEX CONTINUITY SYSTEM.

SIMPLEX STEEL CONDUIT COMPANY.

The service cut-outs exhibited are of new design, being so arranged that when they are opened the current is automatically cut off. This prevents any chance of a shock being sustained while replacing a blown fuse. The hinged iron box is made in two distinct parts, the lower part carrying special forms of clip terminals for connecting the cables, and the top portion having contact pieces for the fuse. The cover of the box can therefore be entirely removed for replacing the fuse.

The Simplex continuity system is a most important feature of the system. A split bush or nipple, with plain interior and screwed on the outside, is screwed into a coupling or other fitting, and the conduit socketed into it, the enamel being first scraped from the end of the tube for about an inch. The bush is then screwed

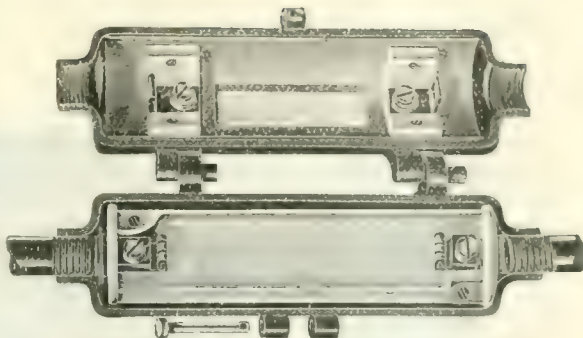
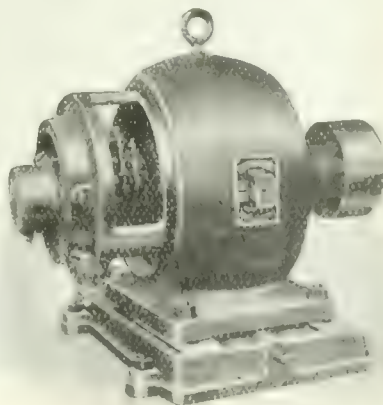


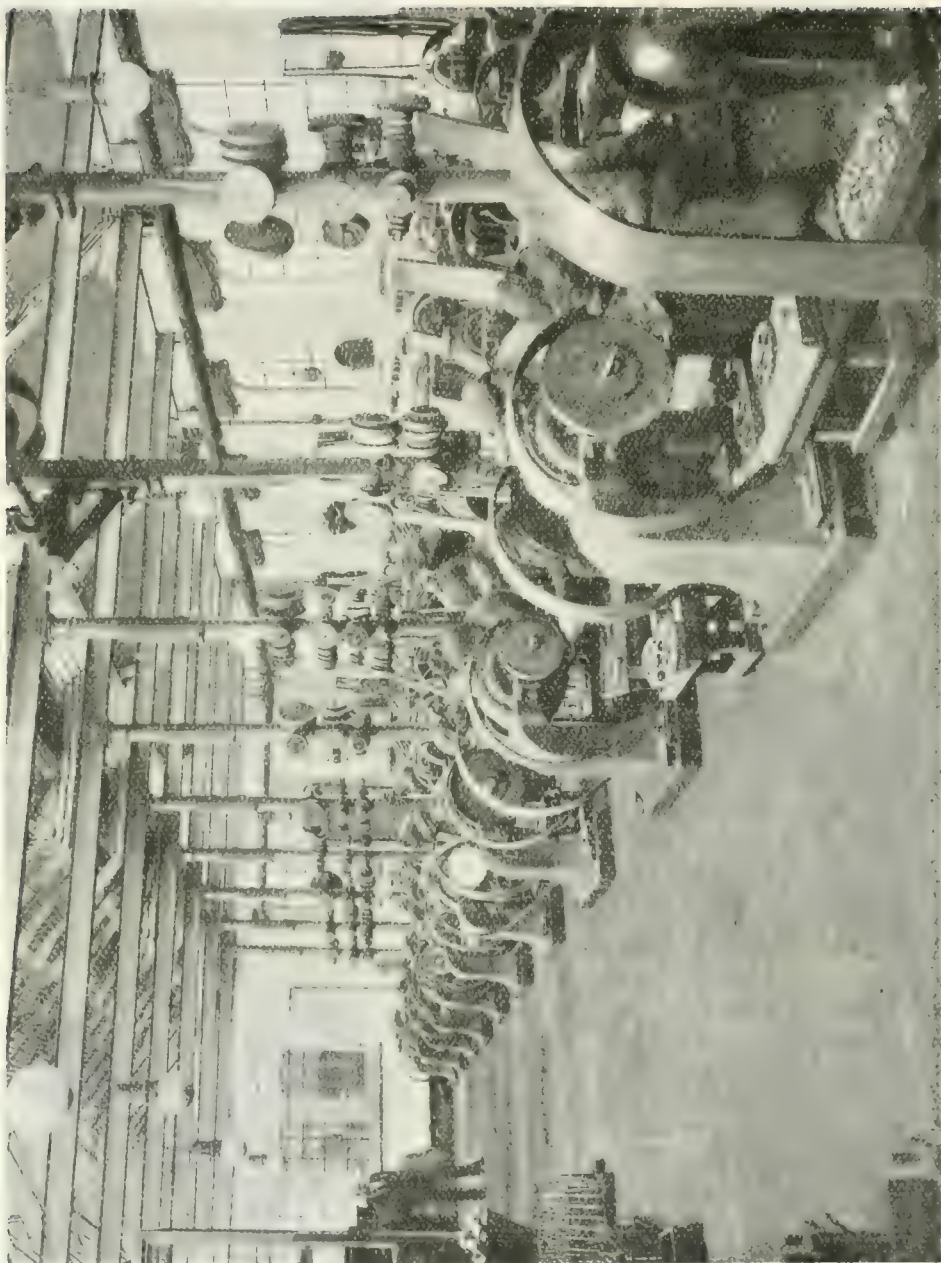
FIG. 4. SIMPLEX HOUSE SERVICE CUT-OUT.

home by means of a spanner and binds down on the tube making a good contact. This ensures electrical continuity between the tube and fitting and an installation thus erected may be efficiently earthed.

ELECTROMOTORS, LTD.

This firm is showing a complete range of motors from $\frac{1}{4}$ to 25 h.p. They are of the new type, and vary from the original motors, inasmuch that there is easier access to the brushes and internal parts of the motor on account of the portion of the motor body over the commutator having been materially increased in diameter. They are also fitted with the new patent brush holder. A complete range of these motors extends along the front of the stand, and by means of a special switchboard they can be started and stopped automatically in rotation. This switchboard is built up of solenoid main switches, and solenoid self-starting switches, which are brought into operation by means of a motor-driven master drum, resulting in

FIG. 5. OPEN PROTECTIVE DYNAMOMETER.
ELECTROMOTORS, LTD.



LAUNIER ELECTRICAL COMPANY, LTD.
ILLUSTRATING THE INDIVIDUAL DRIVING OF MACHINES.

an automatic system of control which is in operation throughout the day, starting and stopping the different motors in turn without an operator's attention. The solenoid switches are of the Sturtevant Engineering Company's manufacture.

The other exhibits comprise new standard spur reduction gear motor; a worm gear motor; and three sizes of the new propeller fans. There is also shown a patent electrically-driven knife cleaner, mounted on board, complete with starter, etc., manufactured by Messrs. Follows and Bate, of Gorton, Manchester. The capacity of the knife cleaner is 1,000 knives per hour, and it is driven by a specially designed motor. We also noted a $\frac{1}{2}$ -h.p. buffing machine, suitable for cleaning arc lamps parts, burnishing switches, etc., and a model service lift.

THE LAHMEYER ELECTRICAL COMPANY, LTD.

This is a decidedly interesting exhibit. The machines shown include a 350-kilowatt motorgenerator consisting of a three-phase synchronous motor, 10,000 volts, 50 periods, capable of an output of 520 b.h.p., direct coupled, with a continuous current dynamo for an output of 350 kilowatts at a terminal voltage of 220-240 volts. The motor is of the revolving field type, the field coils being wound for a voltage of 220 volts. During the exhibition this set is being used for the purpose of generating three-phase current at 2,000 volts for driving the haulage gear; to obtain a periodicity of 25 cycles as required by the haulage gear motor, the motor generator is run at half-speed. This is obtained by a reduction of the terminal pressure, the 30-kilowatt booster, being inserted in series with the motor. A great many motor generators of this type are working in this country.

The 30-kilowatt booster consists of a 47-h.p. continuous current motor, 220 volts driving on the same shaft the 30-kilowatt variable voltage generator. The field coils of this generator are wound for a voltage of 220 volts, and by means of a field regulator the terminal pressure can be regulated between zero and 70 volts. The generator is provided with compensating poles, which arrangement is a speciality of this company.

In the case of the 100 h.p. haulage gear shown the gear is driven by a totally enclosed motor rated for an output of 200 h.p., with a temperature rise of 70 deg. F., after ten hours' continuous running. The motor is built for a voltage of 2,200 volts 25 cycles three-phase current at a speed of 187 revolutions per minute. This comparatively low speed was adopted to avoid a double reduction gear, and to obtain a more efficient combination.

As is generally the case with electric motors driving stationary machinery, the energy stored in the revolving armature of the motor is rather considerable. This is of quite special importance when the haulage gear has to be suddenly stopped. A very powerful brake has, therefore, been arranged on the first motion shaft, which is to be used generally for stopping the haulage gear, and also as an emergency brake. The controller is of the horizontal type and arranged for two phases according to the winding of the motor armature.

On account of very considerable speed variation being required in this particular case, the resistances are provided with oil circulating pump driven by belt from the motor coupling. This pump circulates the oil through the cooling tubes, which can be arranged anywhere in the neighborhood of the haulage gear.

The Lahmeyer Schuler Patent Single-Phase Motor is also exhibited. This motor has been specially designed to meet the demand for a single-phase motor which, when starting on load, will not absorb a heavy current, which would cause fluctuations in the mains. The design is a combination of the repulsion and induction motor principles, the motor being provided with one armature, slip rings, and commutator.

By means of the commutator the motor obtains approximately the starting torque of a series wound motor, and on attaining synchronous speed the brusher on the slip rings are short circuited. The motor has a definite maximum speed as just ordinary induction motor.

It is very applicable for lift work, where the frequent starting and stopping tax the mains very heavily.

"DEY" TIME REGISTER.

Messrs. Howard Bros., the manufacturers of these machines make an attractive display. The "Dey" Register has already been described in PAGE'S WEEKLY, and its advantages are widely recognised.

The latest improvement, and it is a very important one, in connection with these machines is the recent invention of Mr. F. Muncaster Howard, and provides means whereby an employee arriving at his work after the specified time, or it may be a departure out of the ordinary time, makes his registration in such a manner as to be conspicuous or readily seen when the combined time and wages sheet or cost card is examined. In carrying out this invention employment has been made of an ink ribbon having two or more ink surfaces of different colours; for instance, one half the ribbon may be black and the other red, the black being ordinary time, the red to indicate late or unusual times.

Some of the machines on the stand are connected by the silent electric impulse system.

NAVAL NOTES.

SIR ANDREW NOBLE, presiding at the annual meeting of Sir W. G. Armstrong, Whitworth and Co., congratulated the shareholders on the fact that the directors were able to pay the same excellent dividend as before, and informed them that the works were satisfactorily supplied with orders. Expenditure on the renewal of plant was due to the fact that their machines had not the power necessary for the high-class steel that was now made at Openshaw, and to the fact that their lathes were not long enough to take the large calibre guns. In the old class of battleships they frequently found guns of four or five different calibres in the heavy armament going, for example, from 12 in. down to 6 in. ; but the newest designs were for two main calibres only, one for heavy armament and one for lighter armament. Experiments had been very costly, but they could do nothing if they did not constantly and continually experiment with artillery. In testing a gun the cost of firing a single shell was as much as £300 or £400. They had advanced also in torpedoes. He thought the success of the Elswick material in the war just ended must be a source of much gratification to them all.

At the luncheon following the launch of the first-class cruiser *Natal* at Barrow, a hearty tribute was paid by the Duke of Devonshire to the efficiency and completeness of Messrs. Vickers, Sons and Maxims' works. In the course of his reply to the toast of success to the firm, Mr. Albert Vickers said it was therefore a satisfaction to them to have built a cruiser which marked a great step in respect of gun power. Indeed he was inclined to look with something of pathetic interest on the *Natal*,

because it was just possible that with the demands of naval strategy she would be the last of our British cruisers, the type in the future being merged into battleships, where high speed would be combined with great powers of offence and defence.

The *Natal* has several features which render her a vessel of exceptional importance. In her name recognition is given to the contribution of Natal to the naval expenses ; last year the colony found some £35,000. She represents, too, the latest theories on the subject of armament carrying six 9·2-in. and four 7·5-in. guns, and entirely dispensing with the 6-in. gun. She can fire in a minute no fewer than forty-eight shots, which can be effective at the three-mile range. She will also have two 12-pounders, twenty-four 3-pounders, five Maxim guns, two 18 in. submerged torpedo tubes, one stern torpedo tube. Both the side armour and the barbette armour will be 6 in. thick.

A sister ship of the *Achilles*, *Cochrane*, and *Warrior*, the *Natal* is 480 ft. long, has an extreme breadth of 73 ft. 6 in., and at a mean draught of 27 ft. will displace 13,550 tons. Her speed will be 22 knots, and her two sets of triple-expansion, four-cylinder engines are designed to develop together 23,500 i.h.p., with 135 revolutions per minute. Steam will be supplied from six cylindrical boilers and twenty Yarrow water-tube boilers. The four 7·5 in. guns stand within casemates on the upper deck, also protected by 6 in. armour. For about three-fifths of her length the ship is covered with armour of the same thickness, thinned down first to 4 in. and then to 3 in. over the remaining portion.

OPENINGS FOR TRADE ABROAD.

Spain.

Tenders will be received up to October 19th at the Directorate General of Public Works, Madrid, for the construction of a wharf with buildings and approach for the lighthouse of the Isla Lobeira Grande, via de Corcubion, Coruna. The upset price is about

Mexico.

Manufacturers of electrical plant will find a ready market in Mexico for their productions, the principle source of power in this country being electricity. At the present time a good deal of the machinery utilised is of German origin, but there is now an excellent opening for all manner of electric fittings, as well as for dynamos, cables and all requirements for tram and telegraph installations.

India.

The Belgian Consulate at Bombay calls attention to the extraordinary increase which has been taking place in the importation of automobiles into India. He remarks that they are becoming more and more popular, particularly among the wealthy natives. In Bombay, all types find a good sale, including even the coupé and the victoria to a small extent, but the ordinary type of automobile with four seats is in best demand. Motor cycles are being introduced, and seem likely to come rapidly into use.

Argentina.

According to the Bulletin of the International Bureau of the American Republics, the Minister of Public Works of the Argentine Government has ordered certain of the railway companies of that country to increase their rolling stock as follows: The Great Southern Railway by 1,023 wagons of 30 tons each and 23 locomotives; the Buenos Ayres and Pacific Railway by 920 wagons of 30 tons each and 30 locomotives; The Buenos Ayres and Rosario railway by 339 wagons of 30 tons each and 7 locomotives; the Buenos Ayres Western Railway by 300 wagons of 30 tons each and 20 locomotives; and the Andino Railway by 50 wagons and two locomotives. This new rolling stock must be acquired by the companies before December 31st next. The companies are allowed, in complying with this order, to purchase a greater or less number of wagons than actually specified above, provided the total tonnage aggregates 3,712, 2,400, 1,000, 300, and 100 respectively.

Australian Commonwealth.

The Supply and Tender Board, Adelaide, South Australia, invite tenders until the 25th inst. for the supply of the following materials, delivered in bond, on wharf, Port Adelaide, wharfage to be paid by the contractor:—30 best steel straight axle forgings (three drawings, 1s. each). 60 cast steel engine and tender wheel centres (one drawing, 4s.; one drawing, 1s. 6d). 60 engine and tender tyres (three drawings, 1s. each). 182 best steel straight wagon axles (two drawings, 1s. 6d. each). 364 cast steel wagon wheel centres (two drawings, 5s. each). 364 carriage and wagon crank pin forgings (one drawing, 2s.).

Netherlands.

The Holland Railway Company require tenders by the 9th inst., for the construction of a covered railway, a workshop, and a locomotive shed on the grounds of the central workshop at Haarlem. The estimated cost of the work is £7,625. Further particulars may be obtained from the Company's offices at Amsterdam.

The municipal authorities of Amsterdam are prepared to receive tenders for the construction or placing of the metal superstructure of an iron bridge over the Rapenburgschutsluis. The estimated cost of the work is about £2,858. Tenders should be delivered before the 23rd inst. Conditions of contract, etc., may be obtained from the Stadsdrukkerij of that city.

The acting British Consul at Amsterdam reports that tenders will be received up to noon on October 11th, at the Technical Bureau, Netherlands Colonial Office, The Hague, for the supply of the following material:—Contract No. 404.—1,155 cast-iron supporting pots, partly quite complete, partly without metals and greasing arrangements, for railway carriages and wagons. Contract No. 405.—70 carriage frames, with combined hand and automatic vacuum brake, and 48 reserve spring-handles, with appurtenances. Contract No. 406.—The iron parts with appurtenances for standing water-cocks, and stand-pipes. Contract No. 407.—140,000 rolled and zincd mild steel tirefonds. Contract No. 408.—19,300 short bolts with nuts, and 23,000 large bolts with nuts and rings. Contract Surinam XII.—96,000 Siemens-Martin-iron plates. Contract A. 12.—Corrugated and flat galvanised mild steel bolts, with nuts, screws, rings, nails, etc. Copies of the contract may be obtained from Mr. Mart Nijhoff, The Hague.

SHIPBUILDING NOTES.

On Friday last the turbine steamer *Maheno*, built for the United Steamship Company of New Zealand by Messrs. William Denny and Bros., of Dumbarton, underwent her trial trips. At her first official trial at full power the steamer easily attained a mean speed of 17.5 knots, and at the second trial, which had to be done with a third of the boilers shut down, the speed maintained for six hours, as per contract, was 16.4 knots. The *Maheno* is propelled by a set of Parsons' patent turbines, constructed by Messrs. Denny and Co., of Dumbarton. There are three turbines, one high and two low pressure, working three shafts, with three propellers in all. The condensers are placed fore and aft, at the side of the turbines. Steam is supplied by four cylindrical tubular boilers, two double-ended and two single, at a working pressure of 150 lb. per square inch, and fitted with Howden's system of forced draught. The go-astern turbines are contained within the low pressure, and work on the wing shafts. The reversing gear is well arranged, the whole of the engines being easily controlled by one engineer.

There was launched from the shipyard of Messrs. Cochrane and Sons, shipbuilders, Selby, on Monday a steel screw trawler, the principal dimensions being 127 ft. by 22 ft., by 11 ft. 6 in. depth of hold. The vessel was built to the order of the Anchor Steam Fishing Company, Ltd., of Grimsby, and will be fitted with powerful triple-expansion engines by Messrs. C. D. Holmes and Co., of Hull. As the vessel left the ways she was christened the *Emperor* by Miss A. T. Taylor, of Birkenhead.

Messrs. William Gray and Co., Ltd., launched on the 28th ult., the steel-screw streamer *Northwaite*, which they have built for Messrs. The Raithwaite Steamship Company, Ltd. She will take the highest class in Lloyd's, and is of the following dimensions, viz., length overall, 354 ft. 6 in.; breadth, 49 ft. 6 in.; and depth, 27 ft. 6 in.; with long bridge, poop and topgallant forecastle. The saloon, state rooms, captain's, officers' and engineers' rooms, etc., will be fitted up in houses on the bridge deck and the crew's berths in the forecastle. The hull is built with deep frames, cellular double bottom, and aft peak ballast, six steam winches, steam steering gear amidships, hand screw gear aft, patent direct steam windlass, large donkey boiler,

grain divisions throughout, Stockless anchors, telescopic masts with fore and aft rig, boats on beams overhead and all requirements for a first-class cargo steamer. Triple-expansion engines having cylinders 25 in., 40½ in. and 67 in. diameter, with a piston stroke of 45 in., and two large steel boilers for a working pressure of 180 lb. per square inch, will be supplied by the Central Marine Engine Works.

On Monday the large new steamer *Harley* ran a satisfactory official trial trip in Hartlepool Bay, averaging 11 knots in bad weather. The vessel is over 375 ft. in length, is built on the deep-frame principle, with two steel decks, poop, bridge and forecastle, and takes Lloyd's highest class. Cellular double bottom all fore and aft for water ballast with after peak available as a tank. Large hatches worked by nine powerful steam winches, wood shifting boards throughout patent steam and hand steering gear, patent windlass, large multitubular donkey boiler and all modern auxiliaries are fitted. The vessel has been built by Messrs. Furness, Withy and Co., Ltd., Hartlepool, for London owners. The machinery was supplied by Messrs. Richardsons, Westgarth and Co., Ltd., Hartlepool, and the sizes of cylinders are 24 in., 39 in., 66 in. by 45 in. stroke, and two boilers 16 ft. by 10 ft. 9 in. long, 180 lb. working pressure, built to pass German law. The vessel proceeded to the Tyne after trial trip to load for Alexandria.

The new steamer *Peruviana*, 350 ft. by 46 ft. by 26 ft. 1 in., built by Messrs. Ropner and Son, Stockton-on-Tees, for Messrs. Gladstone and Co., of West Hartlepool, on account of Messrs. Furness, Withy and Co., Ltd., made her official trial trip in the Tees Bay, on Monday, when she averaged 11½ knots per hour. The vessel has been built to Lloyd's highest class on the three deck rule, having poop, long bridge, and topgallant forecastle. She is designed to carry 5,300 tons on Lloyd's summer freeboard, and is fitted with double bottom for water ballast on the cellular principle fore and aft, and in the after peak. She is fitted with triple-expansion engines by Messrs. Blair and Co., Ltd., of Stockton-on-Tees. The vessel has been built under the superintendence of Mr. Brockett, West Hartlepool.

CONTRACTORS' NEWS.

We shall be pleased to insert under this column, free of charge, particulars of open contracts.

CONTRACTS OPEN.

1895.

Lanark.—Supplying and laying within the Lesmahagow special water supply district 100,000 ft. of 12 in. and 14 in. cast-iron pipes, varying from 14 in. to 3 in. diameter with other relative work, for the Upper Ward, District Committee of the County Council of Lanark. Messrs. Watson and Stuart, civil engineer, 94, Hope Street, Glasgow.

Last Day.

Saxmundham.—Sinking a borehole, 10 in. diameter and about 150 ft. deep, or if necessary, deeper, and executing other works incidental thereto at Saxmundham, Suffolk, for the Saxmundham Urban District Council. Mr. P. F. Mackenzie Richards, 53, Victoria Street, Westminster.

Oct. 13.

Glasgow.—Supplying 40 new spring buffer and day wagons required for the sewerage department, for the Corporation. Mr. Thos. Melvin, 30, Cochrane Street.

Oct. 7.

Milford (Ireland).—Putting in two sluice gates, etc., at Milford filter beds; also for making a sewer drain at the Milford Pound, for the Milford Rural District Council. Mr. S. Watters, clerk.

Oct. 14.

London, W.—Supply of general stores during 12 months ending October 31, 1906, for the Metropolitan Railway Co. Mr. R. H. Selbie, secretary 32, Westbourne Terrace, London, W.

Oct. 7.

Manchester.—Supply, delivery, and erection of a steel roof, girders, stanchions and sundry ironwork for a boiler-house at the Rochdale Road Gasworks, Manchester, for the Gas Committee. Mr. C. Nickson, superintendent, Gas Department.

Oct. 14.

Gosport.—Carting, handling, excavating for, laying, and jointing about 10 miles of 15 in. and 16 in. cast-iron pipes, castings, valves, and other fittings and works, for the Gosport Waterworks Co. Apply at the Company's Offices.

Oct. 7.

Bournemouth.—Construction of two passenger lifts on the East and West Cliff, Bournemouth, for the Bournemouth Town Council. Borough Engineer.

Oct. 14.

London.—Works in connection with the partial reconstruction of bridges carrying Clerkenwell Road over Metropolitan Railway; Commercial Street East, over Great Eastern Railway; East India Dock Road over North London Railway; and High Street, Kingsland, over North London Railway (docks line) and the reconstruction of bridge carrying Denmark Hill over the London, Brighton, and South Coast Railway for the London County Council. Mr. Maurice Fitzmaurice, Spring Gardens, S.W.

Oct. 10.

Horsforth (near Leeds).—Construction and erection of a suction gas-producing plant and gas-engine capable of producing 32 b.h.p. for the purpose of driving a borehole pump for the Horsforth waterworks, at Scotland Lane, Horsforth, for the Urban District Council. Mr. E. J. Silcock, Park Row, Leeds.

Oct. 14.

London.—The London County Council invites tenders for the supply of two motor steam fire engines. Clerk of the Council, County Hall, Spring Gardens, S.W.

Oct. 17.

Nottingham.—Construction and erection of a suspension bridge, 225 ft. span, over the river Trent at Nottingham, for the Water Committee. Water Engineer, St. Peter's Church-side, Nottingham.

Oct. 10.

Skipton.—Reconstruction of the bridge over the Waller Hill Beck in Brougham Street, Skipton, for the Skipton Urban District Council. Mr. John Mallinson, surveyor, Town Hall, Skipton.

Oct. 17.

London.—Supply and delivery of about 4,210 tons of steel girder tramway rails, together with the fishplates and bolts and nuts, required in connection with the reconstruction for electrical traction of certain of the Council's tramways, for the London County Council. The rails must be made by the acid process. The Engineer's Department, County Hall, Spring Gardens, S.W.

Oct. 12.

Lincoln.—Construction of a raw-water tank, covered clear-water tank, alterations to filter-beds, mains, etc., at their works at Boultham, Lincoln, for the Waterworks Committee. Mr. Neil McK. Barron, C.E., Corporation Offices, Lincoln.

Oct. 17.

Dublin.—The Dublin, Wicklow, and Wexford Railway Company invite tenders for the supply of 1,000 tons bullhead steel rails (85 lb. per lineal yard), with corresponding fishplates; also for the supply of 900 tons bullhead cast-iron chairs. Mr. F. Keogh, secretary.

Oct. 12.

Oct. 12.

COMING CONTRACTS.

Rawtenstall.—An inquiry was held last week into the application of the Council to borrow £12,000 for electric supply. Electric current will be supplied in bulk by the Lancashire Electric Power Co., the Council acting as distributors. The agreement between the Council and the company is for five years.

Scalby.—The Urban District Council having applied for sanction to the borrowing of £2,967 for works of sewerage and £280 for purpose of water supply. Colonel A. G. Durnford has held an inquiry.

Warrington.—An inquiry has been held relative to the applications of the Corporation to borrow £3,000 for electric lighting purposes, and £1,200 for the construction of bacteria beds.

Middlesbrough.—The erection of a transporter bridge is proposed here, and the Rouen bridge of that type has been named as a model for copying. Another at Nantes has also been commended to the Corporation Ferry Committee, and both are to be visited by a deputation, with a view to the construction of one over the Tees.

Hackney. Application is to be made to the London County Council to sanction a loan of £5,008 for electric lighting purposes.

Maidstone.—It has been decided by the Town Council to apply for powers to extend the electric tramways.

Newbury.—Sanction has been received to the borrowing of £2,500 for gasworks extensions.

CONTRACTS CLOSED.

Cardiff.—The Asylums Committee have accepted the tender of Messrs. T. and T. Vicars for the erection of mechanical stokers for the electric lighting station at the new asylum.

West Ham.—The Corporation have placed an order with Messrs. Edgar Allen and Co. for special work in connection with the new tramway junction at Barking Road.

London.—The Empire Roller Bearings Company have secured the contract for supplying roller bearings axle boxes to the Bengal-Nagpur Railway Company for use on heavy goods wagons.

Ebbw Vale.—In connection with the installation of electric street lighting, the following tenders have been accepted: Cables, Messrs. W. I. Glover and Co., £3,703; overhead wires, Messrs. R. W. Blackwell and Co., £6,159; street lamps, Electric Glow Lamp Company, £588 4s. 6d., or with Nernst lamps, 7043 12s. 6d.; meters, the Reason Manufacturing Company and Messrs. Rumney.

Transvaal.—The contract for the installation of a telephone system at the Premier Diamond Mine has been let to Messrs. C. C. George and Co., agent for the British Westinghouse Company, of Johannesburg, for £2,010. The equipment is of the Western Electric Company's make; "Central Battery" system, with a provision for 100 lines, 23 of which will be taken up as a start, all the lines being laid underground.

Finchley.—The British Accumulator Company have secured a contract from Finchley Council for two storage batteries at their new sub-station at £2,761 10s.

Caerphilly.—The Council have accepted the tender of Johnson and Phillips for electric lighting cables, etc., at £4,247 10s. 3d.

London.—The Brush Electrical Engineering Company have secured the following contracts for Swansea Tramways Company: Six single-deck car-bodies mounted on Brush maximum traction trucks and fitted with Brush 1002B motor equipments, four double-deck car-bodies with Radial Trucks and 1002B Brush motor equipments.

APPOINTMENTS VACANT.

West Ham.—The Corporation invite applications for the appointment of electrical engineer to take charge of their electricity supply undertaking. Commencing salary £300, increasing by annual increments of £50 to £500 per annum. Mr. Fred E. Hilleary, Town Hall, West Ham. ... Oct. 12

Gold Coast.—An electrician is required for the Gold Coast Railway to supervise and repair instruments, telephones, etc., and be responsible for the maintenance of telegraph line. Salary £250 a year. Messrs. Preece and Cardew, 8, Queen Anne's Gate, Westminster, S.W. ... Oct. 11

Edinburgh.—Applications are invited for the position of assistant professor of Chemistry at Heriot Watt College, Edinburgh. Salary £225. ... Oct. 10

Wellington, New Zealand.—The Technical Education Board require an instructor in engineering. Salary £300, with £40 passage allowance. High Commissioner for New Zealand, 13, Victoria Street, London, S.W. ... —

Cork.—An assistant head master is wanted for Crawford Municipal Technical Institute, Cork. Salary £200. Mr. E. A. O'Keefe, at the Institute. ... —

APPOINTMENTS FILLED.

West Ham.—The Corporation have appointed Mr. A. F. Hogg as principal of the West Ham Municipal Technical Institute.

Paddington. Mr. A. G. Cooke, M.A., head of the electrical department of Battersea Polytechnic, has been appointed principal of the London County Council's Paddington Technical Institute.

Wigan.—Mr. Haldane G. Cotsworth, A.M.Inst.M.E., has been appointed lecturer in electrical engineering at Wigan and District Mining and Technical College.

Brighton.—Mr. William Marsh has received the appointment of chief engineer and general manager of the Brighton Corporation Tramways.

London.—Mr. E. Shrapnell Smith has accepted the invitation of the council of the Society of Motor Omnibus Engineers to become honorary vice-president of that body.

Share List of Engineering, Electrical, Iron and Steel, and other Companies.

The following is a comprehensive list of Companies in the industries covered by "Page's Weekly," in which shares business is being currently transacted. Additions will be made from time to time as occasion requires. We desire it to be understood that while our Share List will generally be found correct, we do not hold ourselves responsible for any loss or inconvenience that may arise from possible inaccuracies.

STOCK EXCHANGE SETTLING DAYS.—Settling days on the Stock Exchange are as follows:—
Consols: Nov. 2nd. General Settlement: October 13th, 27th, Nov. 15th. Bank Rate, September 28th, 1905, 4 per cent.

I. - ENGINEERING, IRON, AND STEEL COMPANIES.

ENGINEERING, IRON, AND STEEL COMPANIES.—Contd.

Present Amount Subscribed	Shares	Last Dividend	Name	Paid up	Closing Prices	Present Amount Subscribed	Shares	Last Dividend	Name	Paid up	Closing Prices
11,370	5	5	Alldays & Onions Pneumatic Engineering, Ltd.	3	54 2	750,000	1	74	Howard & Bullough, Ltd., Ord.	1	1 1/2
			Do. Cum. Pref. 6 per cent.	5	44 5	25,000	10	6	Do. 6% Pref. (Non-Cum.)	10	12 1/2
10,000	5	3	Do. 4% Cum. Pref.	5	52 5/8	£250,000	Stk	4%	Do. 4% Deb. Stk., Red. after 1905	100	95 3/4
3,210,000	1	1	Armstrong (Sir W. G.), Whitworth and Co., Ltd.	1	5 1/2	37,500	10	20	Kynoch, Ltd.	10	17 1/2
76,970	5	2 1/2	Do. 4% Cum. Pref.	5	44 5	49,537	10	5	Do. Cum. Pref. 5%	10	10 1/2
1,500,000	100	4 1/2	Do. 4% 1st Mort. Dbs. Rd.	100	103 105	300,000	1	44 1/2	Lambert Bros., Ltd., Ord.	10	10 1/2
£100,000	100	4 1/2	Aveling and Porter, Ltd., 4 1/2% Reg. Mt. Dbs. Red.	100	96 90	50,000	5	2 1/2	Do. 5 1/2% Cum. Pref.	5	5 1/2
530,000	1	1 1/2	Babcock and Wilcox, Ltd., Ord.	1	34 42 1/2	40,000	3	2 1/2	Leeds Forge Co., 7% Cum. Pref.	3	4 1/2
100,000	1	7 1/2	Do. 5% Cum. Pref.	1	1 1/2 1 1/2	200,000	1	7 1/2	Lysaght (John), Ltd., 6% Cum. Pl.	1	1 1/2
20,000	5	3	Baker (Joseph) and Sons, Ltd., 6% Cum. Pref.	5	44 5	£300,000	Stk	4 1/2	Do. 4 1/2% 1st Mt. Deb. Stk., Red.	100	10 1/2
250,000	1	6 1/2	Baldwins, Ltd., 5 1/2% Cum. Pref.	1	1 1 1/2	40,000	10	5	Mather & Platt, Ltd., 5% Cum. Pref.	10	11 1/2
£250,000	Stk	4 1/2	Do. 1st Mt. Deb. Stk., Red.	100	102 104	210,000	1	8 1/2	Measures Bros., Ltd., Ord.	1	1 1/2
150,000	4 1/2	2 1/2	Barrow Hematite Steel Co., Ltd., O.	4 1/2	12 12	75,000	1	6 1/2	Do. 5 1/2% Cum. Pref.	1	5 1/2
50,000	4 1/2	3	Do. do. Cum. 2nd. Pref.	4 1/2	4 1/2	£75,000	Stk	4 1/2	Do. 4 1/2% 1st Mt. Deb. Stk., Red.	100	9 1/2
83,344	5	2 1/2	Bayliss, Jones and Bayliss, Ltd., 5 1/2% Cum. Pref. Shares	5	4 1/2 5 1/2	21,943	5	2 1/2	Muntz Metal, Ltd.	5	4 1/2
£500,000	100	4 1/2	Beardmore (Wm.) & Co., Ltd., 4 1/2% 1st Mt. Dbs., Red., Scrip 50% pd.	100	104 100 1/2	14,248	5	5	Do. Pref. Ltd.	5	4 1/2
50,000	10	6 1/2	Bell Brothers, Ltd., 6% Cum. Pref.	10	114 124 1/2	5,000	62 1/2	47 1/2	Nantyglo and Blairston Iron Works, Ltd., 8% Cum. Pref.	62 1/2	79 81
£366,000	Stk	4 1/2	Do. 4 1/2% Deb. Stock, Red.	100	100 102	73,000	10	5 1/2	N. Brit. Loco. Co., Ltd., 5% Cm. Pl.	10	12 1/2
200,000	1	1 1/2	Beyer, Peacock and Co., Ltd., Ord.	1	1 1/2	50,000	5	4 1/2	North-Eastern Steel Co., Ltd., 4 1/2% 1st Mt. Deb. Stk., Red.	100	8 9
300,000	1	6 1/2	Do. 5 1/2% Cum. Pref.	1	1 1/2	£250,000	Stk	4 1/2	Pearson & Knowles Coal and Iron Co., Ltd., Ord. "A"	5	4 1/2
£300,000	Stk	4 1/2	Do. 4 1/2% Red. Deb. Stock	100	93 95	122,000	5	1 1/2	Do. 6% Cum. Pref. "A"	5	4 1/2
1,629,760	1	6 1/2	Bolckow, Vaughan and Co., Ltd., O.	1	1 1 1/2	50,000	5	3 1/2	Pease & Partners, Ltd., Ord.	10	11 1/2
1,860,000	1	3 1/2	Do. Nos. 1,639,101-1,850,000	12 1/2	1 1 1/2	70,000	10	10 1/2	Do. 4% Perp. Deb. Stock	100	10 10 1/2
1,160,000	1	10 1/2	Brown (John) and Co., Lim., Ord.	1	1 1 1/2	£400,000	Stk	4%	Peebles (Bruce) & Co., Ltd., 6% Cm. Pl.	1	4 1/2
			Do. Ord., Nos. 1,160,001-1,750,000	1 1/2	1 1 1/2	20,000	5	3 1/2	Pooley (Henry) & Son, Ltd., Ord.	1	10 11 1/2
590,000	1	1 1/2	Do. 5% Cum. Pref.	10	114 114 1/2	65,000	1	1	Do. 5 1/2% Cum. Pref.	5	4 1/2
74,000	10	5	Cammell, Laird & Co., Ltd., Ord.	5	5 1/2 10 1/2	13,000	5	2 1/2	Projectile Co. (1902), Ltd., Ord.	1	5 1/2
154,500	5	2 1/2	Do. 5% Cum. Pref.	5	5 1/2 10 1/2	230,000	5	2 1/2	Rhymney Iron Co., Ltd.	5	1 1/2
232,500	5	2 1/2	Clayton & Shuttleworth, Ltd., Ord.	1	1 1/2	73,062	5	2 1/2	Do. New	5	1 1/2
450,000	1	1 1/2	Do. 5% Cum. Pref.	5	5 1/2 10 1/2	£390,000	—	5	Do. 5% Mort. Deb., Red.	100	10 10 1/2
70,000	5	2 1/2	Do. 4% 1st Mort. Deb. Stk., Red.	100	100 102	350,000	1	7 1/2	Richardsons, Westgarth & Co., Ltd., Ord. 350,001-700,000	1	1 1/2
£250,000	Stk	4 1/2	Consett Iron Co., Ltd., Ord.	7 1/2	3 1/2 3 1/2	£350,000	Stk	4 1/2	Do. 6% Cum. Pref.	1	1 1/2
100,000	10	8 1/2	Crossley, Bros., Ltd., Ord. 40340/97370	10	15 1/2 15 1/2	35,000	10	12 1/2	Do. 4 1/2% Perp. Deb. Stock	100	9 9 1/2
57,031	10	10 1/2	Do. 5% Cum. Pref.	10	11 11 1/2	275,000	1	6 1/2	Ruston, Proctor & Co., Ltd., 100	10 10 1/2	
40,839	10	5	Delta Metal, Ltd. Shares	1	2 1/2 2 1/2	300,000	1	7 1/2	Scott (Walter) Ltd., Ord.	1	4 1/2
75,000	1	2 1/2	Dorman, Long & Co., Ltd.	1	4 1/2	£300,000	Stk	4 1/2	Do. 6% Cum. Pref.	1	1 1/2
1,250,94	1	3 1/2	Do. 4 1/2% 1st Mt. Deb. Stk.	100	90 94	£115,300	100	5	Do. 4 1/2% Perp. Deb. Stk.	100	9 9 1/2
£400,000	Stk	4 1/2	Dunderland Iron Ore Co., Ltd., 6% Cum. Pref. and Participating	5	3 1/2 4 1/2	£297,900	100	6 1/2	Shelton Iron, Steel and Coal Co., Ltd. 1st Charge 5% Dbs., Red.	100	9 9 1/2
200,000	5	3 1/2	Dunlop (James) & Co., Ltd., Ord.	1	1 1/2 1 1/2	250,000	1	1 1/2	Do. 6% and Mort. Dbs., Red.	100	9 9 1/2
250,000	1	7 1/2	Do. 6% Cum. Pref.	1	1 1/2 1 1/2	300,000	1	1 1/2	South Durham Steel & Iron, Ltd. Or.	1	1 1/2
300,000	1	7 1/2	Ebbw Vale Steel, Iron & Coal Co., Ltd.	13	9 1/2 10 1/2	£300,000	Stk	4 1/2	Do. 6% Cum. Pref.	1	1 1/2
4,721	13	14	Do. do. do.	10	8 1/2 8 1/2	49,550	10	2 1/2	Do. 4 1/2% Perp. Deb. Stock	100	9 9 1/2
69,754	13	10 1/2	Edgott's Metal, Ltd.	8	5 1/2 5 1/2	£125,240	Stk	5	Steel Co. of Scotland Ord. 1/49560	9	7 1/2
20,250	10	8 1/2	Do. Cum. Pref. 3%	10	8 1/2 9 1/2	25,000	10	25,000	Do. 5% Trust Mort. Deb	100	10 10 1/2
5,000	10	5	Do. Deb. 4%	100	90 94	25,000	10	5 1/2	Stephenson (Robert) & Co., Ltd., Or.	1	1 1/2
186,718	Stk	4 1/2	Fairfield Shipbuilding & Engng. Co., Ltd., 6 1/2% Cum. Pref.	10	11 1/2 11 1/2	85,000	10	5 1/2	Do. 5 1/2% Cum. Pref.	10	9 1/2
25,000	10	6 1/2	Do. 4 1/2% Mort. Deb. Stk., Red.	100	100 103	65,000	10	6 1/2	Do. 4 1/2% Perp. Deb. Stock	100	9 9 1/2
£250,000	Stk	4 1/2	Fleming & Ferguson, Ltd. Ord. Nos. 1-3000	10 1/2	12 1/2 12 1/2	684,732	1	6 1/2	Stewarts & Lloyds, Ltd., Ord.	10	1 1/2
9,000	10	10 1/2	Do. 5% Cum. Pref. Nos. 3001/15000	10	9 1/2 10 1/2	538,845	1	6 1/2	Swan, Hunter & Wigham-Richardson, Ltd. Ord.	1	1 1/2
6,000	10	5	Fraser & Chalmers, Ltd., Ord.	3	3 1/2 4 1/2	£240,000	Stk	4 1/2	Do. 5% Cum. Pref.	1	1 1/2
126,000	3	3 1/2	Do. 7 1/2% Cum. Pref.	3	5 1/2 6 1/2	300,000	1	6 1/2	Do. 4 1/2% 1st Mort. Deb. Stk., Red.	100	9 9 1/2
21,000	3	1 6	Galloway, Ltd., Cum. Pref.	10	6 1/2 7 1/2	£200,000	100	4 1/2	Thames Iron Works, Engineering & Engineering Co., Ltd., Cum. Pref.	1	1 1/2
10,000	10	5 1/2	Do. 4 1/2% 1st Mort. Deb. Red.	100	88 89 1/2	£148,300	1	7 1/2	Do. 4 1/2% Irredeem. 1st Mort. Deb.	100	8 1/2 8 1/2
£150,000	Stk	4 1/2	Greenwood & Bartley, Ltd., Ord.	10	6 1/2 7 1/2	£160,000	1	7 1/2	Thornycroft (John I.) & Co., Ltd. Or.	1	1 1/2
16,400	10	10 1/2	Do. 7 1/2% Cum. Pref.	10	10 10 1/2	10,000	10	5	Do. 5% Cum. Pref.	10	9 1/2
9,600	10	7 1/2	Guest, Keen & Nettlefolds, Ltd. Ord.	1	2 1/2 2 1/2	£58,955,200	£100	5 1/2	Taylor J. & Son, Ltd. 5% Cum. Pref.	10	4 1/2
965,000	1	1	Do. 5% Cum. Pref.	5	6 1/2 6 1/2	£63,311,000	£100	8 1/2	United States Steel Corp. Cum. Stk.	£100	10 1/2
344,000	5	2 1/2	Hadfield's Steel & Iron Co., Ltd., Ord.	1	4 1/2 4 1/2	£102,681,000	£1000	5 1/2	Do. 7% Cum. Pref. Stock	£100	10 1/2
£1,850,500	Stk	4 1/2	Hall (J. & E.), Ltd. 6% Cum. Pref.	5	5 1/2 5 1/2	£1,100,000	1	1 1/2	Do. 10% Cum. Pref.	£1000	10 1/2
13,000	5	2 1/2	Harvey United Steel Co., Ltd.	1	2 1/2 2 1/2	750,000	1	6 1/2	Vickers, Sons & Maxam, Ltd., Ord.	1	1 1/2
250,000	1	1 1/2	Hawthorn, Leslie & Co., Ltd. Ord.	10	7 1/2 7 1/2	£750,000	Stk	5	Do. 5% Non-Cum. Pref. Stock	100	1 1/2
20,000	10	4 1/2	Head, Wrightson & Co., Ltd.	7	7 1/2 7 1/2	£1,250,000	Stk	4 1/2	Do. 4 1/2% 1st Mt. Deb. Stk., Red.	100	10 10 1/2
30,000	5	3 1/2	Hill, Richard & Co., Ltd. Ord.	1	7 1/2 7 1/2	£1,000,000	100	1 1/2	Do. 4 1/2% 1st Mt. Deb. Stk., Red.	100	10 10 1/2
408,000	1	1 1/2	Do. 7 1/2% Cum. Pref.	1	7 1/2 7 1/2	225,000	1	1 1/2	Weardale Steel, Coal & Coke Co., Ltd. Ord.	1	1 1/2
47,000	10	7 1/2	Hornby (Richard) & Co., Ltd., O.	100	88 100	700,000	1	7 1/2	Do. 6% Cum. Pref. Ord.	1	1 1/2
28,601	7	7	Do. 7 1/2% Cum. Pref.	1	7 1/2 7 1/2	£900,000	Stk	4 1/2	Do. 4 1/2% 1st Mort. Deb. Stk., Red.	100	8 1/2
8,000	1	7 1/2	Hornby (Richard) & Co., Ltd., O.	100	88 100	7,637	1	2 1/2	Do. 6% Cum. Pref.	100	8 1/2
18,000	1	7 1/2	Do. 7 1/2% Cum. Pref.	1	7 1/2 7 1/2	300	Stk	4 1/2	Do. 4 1/2% 1st Mort. Deb. Stk., Red.	100	8 1/2
£100,000	Stk	4 1/2	Hornby (Richard) & Co., Ltd., O.	100	88 100	£210,641	Stk	4 1/2	Do. 6% Cum. Pref.	100	8 1/2
			6% Cum. Pref.			£150,000	Stk	4 1/2	Do. 4 1/2% 1st Mort. Deb. Stk., Red.	100	8 1/2

STOCK AND SHARES MARKED * ARE QUOTED IN LONDON.

II. ELECTRICAL MANUFACTURING COMPANIES.

Present Amount Subscribed.	Shares	Last Dividend	Name	Paid up	Closing Prices.
70,000	1	6d.	Alliance Elec. Co., Ltd., 5% Cum. Pf.	1	4-2
125,000	1	7 1/2d.	Aron Elec. Meter Ltd., 5% Cum. Pf.	1	13-15
120,000	1	1 1/2d.	Bell's Asbestos Co., Ltd.	1	13-15
100,000	5	9d.	British Aluminium Co., 7% Cum. Pref.	1	13-15
£200,000	Stk	5 1/2	Do. 5% 1st Mort. Deb. Stk. Rd.	100	90-100
100,000	6	4 1/2	British Insulated & Helsby Cables Ltd., Ord.	5	6 1/2-6 3/4
100,000	5	3 1/2	Do. 6% Cum. Pref.	5	5 1/2-5 3/4
£200,000	Stk	4 1/2	Do. 4 1/2% 1st Mort. Deb. Stk. Rd.	100	103-105
£200,000	Stk	4 1/2	British Thomson Houston Co., Ltd., 4 1/2% 1st Mort. Deb. Stk. Rd.	100	98-100
400,000	5	9 1/2	British Westinghouse Electric and Manufac. Co., Ltd., 8% Pref.	5	25-26
£616,651	Stk	1 1/2	Do. 4% Mort. Deb. Stk. Rd.	100	85-89
105,711	2	2 1/2	Brush Elec. Enging. Co., Ltd., Ord.	2	4-5
150,000	2	2 1/2	Do. 6% Pref.	2	1-1
£125,000	Stk	4 1/2	Do. 4 1/2% Perp. 1st Deb. Stk.	100	91-94
£125,000	Stk	4 1/2	Do. 4 1/2% Perp. 2nd Deb. Stk.	100	78-81
45,000	5	7 1/2	Callender's Cable & Constn. Ltd., Ord.	5	10 1/2-11 1/2
40,000	5	2 1/2	Do. 5% Cum. Pref.	5	5 1/2-5 3/4
£200,000	Stk	1 1/2	Do. 4 1/2% 1st Mort. Deb. Stk. Rd.	100	100-111
8,000	3	1 1/2	Crompton & Co., Ltd.	3	1-1 1/2
£100,000	5	5	Do. 5% 1st Mort. Reg. Debs.	100	95-100
32,000	5	10 1/2	Dick, Kerr & Co., Ltd., Ord.	5	8 1/2-9
61,000	5	3	Do. 6% Cum. Pref.	5	6-6 1/2
£300,000	Stk	4 1/2	Do. 4 1/2% Deb. Stock, Red.	100	106-108
283,334	1	6d.	Doulton & Co., Ltd., 5% Cum. Pref.	1	14-15
£283,334	Stk	1 1/2	Do. 1st Mort. 1st Deb. Stk.	100	106-109
100,000	5	1 1/2	Edison and Swan United Electric Light, Ltd., "A" Shares	3	1-1 1/2
17,139	5	2 1/2	Do. "A" Shares Nos. 01 017,139	5	2-2 1/2
£344,023	Stk	4 1/2	Do. 4 1/2% Deb. Stock, Red.	100	83-88
£100,000	Stk	5 1/2	Do. 5% Second Deb. Stk. Rd.	100	90-90 1/2
112,100	2	1 1/2	Electric Construction Co., Ltd.	2	1-1 1/2
31,890	2	2 1/2	Do. 7% Cumulative Pref.	2	1 1/2-2 1/2
£200,000	Stk	4 1/2	Do. 4 1/2% Perp. 1st Mt. Deb. Stk.	100	92-95
10,248	10	7 1/2	Evered and Co., Ltd.	10	10-12
25,000	10	5 1/2	Gen. Elect. Co. (1900), Ltd., 5% Cum. Pref.	10	9 1/2-10
£200,000	Stk	4 1/2	Do. 4 1/2% 1st Mt. Deb. Stk. Rd.	100	96-100 1/2
35,000	5	5 1/2	Henley's (W. T.) Telegraph Works Co., Ltd., Ord.	5	12-13
35,000	5	2 1/2	Do. 4 1/2% Cum. Pref.	5	5 1/2-5 3/4
£50,000	Stk	4 1/2	Do. 4 1/2% Mt. Deb. Stk. Rd.	100	109-111
50,000	10	5 1/2	India Rubber, Gutta Percha & Telegraph Works Co., Ltd., 1st Mort. Deb. Rd.	100	15 1/2-16 1/2
£300,000	100	4 1/2	Do. 1st Mort. Deb. Rd.	100	99-102 1/2
7,500	10	7	Parker, Thos. Ltd.	10	6 1/2-7
100,000	1	3 1/2	Scott (Ernest) & Mountain, Ltd., Ord.	1	16 1/2-16 7/8
37,350	12	12 1/2	Telegraph Construction and Maintenance Co., Ltd.	12	34-36
£150,000	100	4 1/2	Do. 4 1/2% Deb. Bonds	100	102-104

III.—ELECTRIC TRACTION.

Present Amount Subscribed.	Shares	Last Dividend	Name	Paid up	Closing Prices.
120,000	5	7 1/2	Anglo-Argentine Trams Co., Ltd., Ord.	5	8 1/2-8 3/4
260,007	5	2 1/2	Do. 5% Cum. Pref.	5	10-10 1/2
£230,000	Stk	6 1/2	Do. Permanent 6% Debenture Stock, 1888	100	141-144
20,000	10	12 1/2	Barcelona Trams Co., Ltd., Ord.	10	13 1/2-14 1/2
10,000	10	5 1/2	Do. 5% Cum. Pref. Shares	10	9 1/2-10
£46,300	100	5 1/2	Do. 5% Debs., Red.	100	98-101
£191,326	Stk	4 1/2	Do. 4 1/2% Red. Deb. Stk.	100	97-102
75,606	1	11 1/2	Bath Elec. Trams, Ltd., Pf. Or.	1	10-11 1/2
59,394	1	11 1/2	Do. 5% Cum. Pf.	1	10-11 1/2
75,000	5	5	Brisbane Electric Tram Investment Co., Ltd., Ord.	5	1-1 1/2
75,000	5	2 1/2	Do. 5% Cum. Pf.	5	4-4 1/2
£125,000	Stk	4 1/2	Do. 4 1/2% 1st Deb. Stk. Rd.	100	96-98
£200,000	Stk	6 1/2	Brit. Columbia Elec. Rly. Co., Ltd., Def. Ord. Stock	100	12 1/2-13
133,301	10	6 1/2	Do. Pref. Ord. Stock	100	104-107
156,487	10	6 1/2	Brit. Electric Traction, Ltd., Ord.	10	9-9 1/2
£1,000,000	Stk	5 1/2	Do. 5% Cum. Pref.	10	10 1/2-11
£200,000	Stk	4 1/2	Do. 5% Perp. Deb. Stk.	100	12 1/2-13 1/2
100,000	5	2 1/2	Do. 4 1/2% 2nd Deb. Stk. Rd.	100	90-101
40,500	5	3 1/2	Buenos Ayres & Belgrano Electric Trams, Ltd., Ord.	5	3 1/2-4
37,000	5	3 1/2	Do. "A" 6% Cum. Pref.	5	3-3 1/2

ELECTRIC TRACTION.—Contd.

Present Amount Subscribed.	Shares	Last Dividend	Name	Paid up	Closing Prices.
£200,000	Stk	5 1/2	Buenos Ayres Elec. Trams Co. (1901) Ltd., 5% Db. Stk., Red.	100	103-107
£220,000	100	5 1/2	Buenos Ayres Gd. N. Co., Ltd., 6 1/2% 1st Deb. Bds.	100	103-107
102,268	5	5 1/2	Calcutta Tramways Co., Ltd.	5	92-94
£350,000	Stk	4 1/2	Do. 4 1/2% 1st Deb. Stk., Red.	100	107-108
480,000	1	6d.	Cape Electric Trams, Ltd.	1	13-15
40,000	5	2 1/2	City of Birmingham Trams Co., Ltd., 5% Cum. Pref.	5	12-12 1/2
£300,000	100	4 1/2	Do. 4 1/2% 1st Mort. Debs.	100	100-101
£120,000	Stk	5 1/2	Colombo Elec. Tram. & Light. Co., Ltd., 5% 1st Mort. Deb. Stk. Rd.	100	103-105
60,000	10	6 1/2	Dublin United Trams Co. (1896), Ltd., Ord.	10	134-144
59,987	10	6 1/2	Do. 6% Pref.	10	14-16
30,000	5	2 1/2	Isle of Thanet Elec. Trams. and Light. Co., Ltd., 5% Cum. Pref.	5	2 1/2-3
£150,000	Stk	4 1/2	Do. 4 1/2% Deb. Stock	100	88-90
125,000	10	5 1/2	London United Trams (1901), Ltd., 5% Cum. Pref.	10	10-10 1/2
£1,031,000	Stk	4 1/2	Do. 4 1/2% 1st Mort. Deb. Stk. Rd.	100	101-103
£50,000	Stk	5 1/2	Madras Electric Trams (1904), Ltd., 5% Deb. Stock, Red.	100	103-105
314,016	1	—	Metropolitan Elec. Trams, Ltd., Def.	1	1-1 1/2
500,000	1	6d.	Do. 5% Cum. Pref.	1	1-1 1/2
£350,000	Stk	4 1/2	Do. 4 1/2% Deb. Stock, Red.	100	107-107 1/2
50,000	5	6 1/2	New General Traction Co., Ltd., 6% Cum. Pref.	5	4-4 1/2
110,923	8	2 1/2	North Metropolitan Tramways Co., Do.	8	4 1/2-5
£150,000	100	3 1/2	Do. 3 1/2% Mort. Debs.	100	95-98
£196,200	Stk	5 1/2	Perth Electric Trams, Ltd. (W.A.), 5% 1st Mort. Deb. Stock, Red.	100	104-107
24,500	10	10 1/2	Potteries Elec. Traction Co., Ltd., Ord.	10	8 1/2-9
24,500	10	5 1/2	Do. 5% Cum. Pref.	10	9-9 1/2
£220,000	Stk	4 1/2	Do. 4 1/2% Deb. Stk., Red.	100	101-104 1/2

IV.—ELECTRIC LIGHTING AND POWER.

Present Amount Subscribed.	Shares	Last Dividend	Name	Paid up	Closing Prices.
7,500	10	14 1/2	Bournemouth & Poole Elec. Sup. Co., Ltd., Ord.	10	10-10 1/2
7,500	10	4 1/2	Do. 4 1/2% Cum. Pref.	10	10-10 1/2
7,500	10	6 1/2	Do. 6% Cum. Second Pf.	10	11-11 1/2
£70,000	Stk	4 1/2	Do. 4 1/2% Deb. Stock, Red.	100	106-108
14,000	5	3 1/2	Bromley (Kent) Elec. Lt. & Pr. Co. Ltd.	5	10 1/2-11
£50,000	Stk	4 1/2	Do. do 4 1/2% 1st Deb. Stk. Rd.	100	104-105 1/2
27,507	4	4 1/2	Brompton & Kensington Elec. Supply Co., Ltd., Ord.	5	9 1/2-10 1/2
12,493	5	3 1/2	Do. 7% Cum. Pref. Shares	5	9 1/2-10 1/2
60,000	5	5 1/2	Calcutta Elec. Sup. Cor. Ltd., Ord.	5	9 1/2-10
£288,782	Stk	4 1/2	Central Elec. Sup. Co., Ltd., 4 1/2% Gaa. Deb. S.k.	100	100-106
70,000	5	2 1/2	Charing Cross & Strand Elec. Sup. Corp., Ltd., Ord.	5	9 1/2-10 1/2
80,000	5	2 1/2	Do. do 4 1/2% Cum. Pref.	5	10-10 1/2
£350,000	Stk	4 1/2	Do. do 4 1/2% Deb. Stk. Rd.	100	103-105
41,436	5	2 1/2	Chelsea Elec. Sply. Co., Ltd., Ord.	5	10 1/2-11
£150,000	Stk	4 1/2	Do. do 4 1/2% Deb. Stk., Red.	100	103-111
70,595	10	7 1/2	City of London El. Light. Co., Ltd., O.	10	11-11 1/2
40,000	10	6 1/2	Do. 6% Cum. Pref.	10	13-14
£400,000	Stk	5 1/2	Do. 5% Deb. Stk., Red.	100	104-105
£300,000	Stk	4 1/2	Do. 4 1/2% 2nd Deb. Stk., Red.	100	104-105
40,000	10	4 1/2	County of London Elec. Supply Co., Ltd., Ord.	10	10 1/2-11
30,000	10	6 1/2	Do. 6% Cum. Pref.	10	11-11 1/2
£400,000	Stk	4 1/2	Do. 4 1/2% Deb. Stk., Red.	100	111-113
70,000	5	2 1/2	Edmundson's Elec. Cor. Ltd., Ord.	5	10-10 1/2
70,000	5	3 1/2	Do. 6% Cum. Pref.	5	10 1/2-11
£300,000	Stk	4 1/2	Do. 4 1/2% 1st Mort. Deb. Stk. Rd.	100	105-110
£280,000	Stk	5 1/2	Electric Lighting & Traction Co. of Australia, Ltd., 5% Deb. Stk. Rd.	100	85-90
10,000	5	—	Folkestone Elec. Supply Co., Ltd., O.	5	10 1/2-11
£50,000	Stk	4 1/2	Do. 4 1/2% 1st Deb. Stk., Red.	100	100-103
15,000	10	7 1/2	Havana Electric Co., Ltd.	10	9 1/2-10 1/2
13,000	5	6 1/2	Hove Elec. Lighting Co., Ltd., Ord.	5	8-8 1/2
£50,000	Stk	4 1/2	Isle of Wight Electric Light & Power Co., Ltd., 4 1/2% Deb. Stock, Red.	100	100-103
150,000	1	—	Kalgoorlie Electric Power & Lighting Corp. Ltd., 6% Cum. Pref.	1	—
21,000	5	5 1/2	Kensington and Knightsbridge Electric Lighting Co., Ltd., Ord.	5	12-12 1/2

Stocks and Shares quoted are quoted ex-dividend.

ELECTRIC LIGHTING AND POWER.—Contd.

Present Amount Subscribed	Shares	Last Dividend	Name	Paid up	Closing Prices
£135,000	Stk 4%		Kensington and Knightsbridge Electric Lighting Co., Ltd., and the Notting Hill Electric Lighting Co., Ltd., 4% Deb. Stock, Red.	100	101-103
111,000	3	1 9/16	London Elec. Supply Corp., Ltd., Ord.	3	2-2 3/4
60,000	5	3/-	Do. 6% Pref.	5	1 1/2-1 3/4
£371,895	Stk 4%		Do. 4% 1st Mort. Deb. Stk., Red.	100	99-102
100,000	10	5/-	Metropolitan Elec. Sup. Co., Ltd., Ord.	10	10 1/2-11
76,121	5	2 3/4	Do. 4 1/2% Cum. Pref.	5	5 1/2-5 3/4
220,000	Stk 4 1/2%		Do. 4 1/2% 1st Mort. Deb. Stk., Red.	100	109-11 1/2
250,000	Stk 3 1/2%		Do. 3 1/2% Mort. Deb. Stk., Red.	100	100-102
£250,000	—	4 1/2%	Midland Elec. Corp. for Power Distribution, Ltd., 4 1/2% 1st Mort. Deb.	100	100-102 1/2
10,852	10	8/-	Notting Hill Elec. Ltg. Co. Ltd. Ord.	10	14-15
£59,000	100	4%	Do. 4% 1st Mort. Deb.	100	98-100
16,500	5	2 6/8	Oxford Electric Co. Ltd., Ord.	5	6 1/2-7
£50,000	Stk 4%		Do. 4% Debenture Stk. Red.	100	100-102
£84,700	100	4 1/2%	Royal Elec. Co. (of Montreal) Ltd., 20-v. 1st Mort. Deb.	100	100-102
40,000	5	5	St. James' & Pall Mall Elec. Light Co., Ltd. Ord.	5	14-15
20,000	5	3 6/8	Do. 7% Pref.	5	8-9
£150,000	Stk 3 1/2%		Do. 3 1/2% Debent. Stock, Red.	100	98-100
12,000	5	4/-	Smithfield Markets Elec. Supply Co., Ltd. Ord.	5	2 1/2-3
£50,000	Stk 4%		Do. 4% Debenture Stk. Red.	100	76-80
65,000	5	4/-	South London Elec. Sup. Co., Ltd. O.	5	8 1/2-9
100,000	1	—	South Metropolitan Elec. Light & Power Co., Ltd. Ord.	1	1 1/2-1 3/4
50,000	1	8 1/2d.	Do. 7% Cum. Pref.	1	1 1/2-1 3/4
£100,000	Stk 4 1/2%		Do. 4 1/2% 1st Deb. Stock, Red.	100	105-108 1/2
50,000	5	2 6/8	Urban Electric Supply Co., Ltd., O.	5	4-4 1/2
30,000	5	2 6/8	Do. 5% Cum. Pref.	5	5-5 1/2
£200,000	Stk 4 1/2%		Do. 4 1/2% 1st Mort. Deb. Stk. Red.	100	103-105 1/2
110,000	5	6 1/8	Westminster Elec. Supply Corp. Ltd., Ord.	5	12-13 1/2
23,161	5	2 6/8	Do. 5% Cum. Pref.	5	6 1/2-6 3/4

V.—TELEGRAPH & TELEPHONE COMPANIES.

Present Amount Subscribed	Shares	Last Dividend	Name	Paid up	Closing Prices
£84,800	100	4%	African Direct Tel. Co., Ltd., 4% Mt. Debts. (Series A), Red.	100	99-102
25,000	10	—	Amazon Telegraph Co., Ltd.	10	3-3 1/2
£763,580	Stk 14 1/2%		Anglo-American Tel. Co., Ltd., Ord.	100	6 1/2-6 3/4
£3,118,210	Stk 2%		Do. 6% Preferred Ordinary	100	104-109 1/2
£3,118,210	Stk 2 1/2%		Do. Deferred Ordinary	100	10 1/2-10 3/4
44,000	5	5 1/2	Chili Telephone Co., Ltd.	5	7 1/2-8
£15,000,000	\$100	\$2	Commercial Cable Co., Capital Stk.	\$100	97-99
£1,903,856	Stk 4%		Do. Steel. 500-vr 4% Deb. Stk., Red.	100	9-9 1/2
16,000	10	5/-	Cuba Submarine Tel. Co., Ltd., Ord.	10	17 1/2-18 1/2
6,000	10	10/-	Do. 10% Preference	10	3 1/2-3 3/4
6,000	5	2 1/2	Direct Spanish Telegraph Co., Ord.	5	9 1/2-9 3/4
£30,000	50	4 1/2%	Do. 10% Cum. Preference	50	100-109 1/2
60,710	20	4 1/2%	Do. 14% Debts.	20	11 1/2-12 1/2
£85,800	100	4 1/2%	Direct U.S. Cable Co., Ltd.	100	100-102
£300,000	100	4%	Direct West India Cable Co., Ltd., 14% Reg. Debts.	100	99-101 1/2
£200,000	25	4%	East. & S. African, Ltd., 4% Mt. Debts.	25	101-103 1/2
300,000	10	2 6/8	Do. 4% Rg. Mt. Debts. (Mauritius Subsidy)	10	109-111 1/2
£602,400	Stk 4%		Eastern Extension, Australasia and China, Ltd.	10	109-111 1/2
£1,000,000	Stk 25/-		Do. 4% Mort. Deb. Stk., Perp.	100	106-108 1/2
£2,000,000	Stk 17 1/2		Eastern Tele. Co., Ltd., Ord.	100	141-147
£1,896,814	Stk 1%		Do. 3% Pref.	100	80-82
150,000	10	5/-	Do. 4% Mort. Deb.	100	100-110
£58,700	100	4 1/2%	Great Northern Telegraph Co., Ltd., (of Copenhagen)	10	3 1/2-3 3/4
17,000	25	12 1/2	Halifax and Bermudas Cable Co., Ltd., 4 1/2% 1st Mort. Debts. Red.	100	100-101 1/2
72,680	1	7 1/2d.	Indo-European Tele. Co., Ltd.	25	2 1/2-2 3/4
£1,983,333	Stk 6%		Monte Video Telephone Co., Ltd., O.	1	9-9 1/2
£1,966,667	Stk 5 1/2		National Telephone Co., Ltd., Pref.	100	112-113 1/2
250,000	5	2 6/8	Do. Deferred	100	107-109
£2,000,000	Stk 3 1/2		Do. 5% Non-Cum. 3rd Pref.	5	2-2 1/2
£289,393	Stk 4 1/2		Do. 3 1/2% Deb. Stk., Red.	100	99-101 1/2
179,313	1	8 1/2d.	Do. 4% do.	100	104 1/2-106 1/2
50,000	1	7 1/2d.	Oriental Telephone & Elec. Co., Ltd.	1	1 1/2-1 3/4
£100,000	100	4 1/2%	Do. 6% Cum. Pref.	1	1-1 1/2
11,839	8	4 1/2	Pacific & European Tel. & Guar. Debts. Red.	100	100-101 1/2
58,000	5	3 1/2	Reuter's Telegram Co., Ltd.	8	8-8 1/2
40,000	5	2 6/8	United River Plate Telep. Co., Ltd.	5	7-7 1/2
£179,417	Stk 5%		Do. 5% Cum. Pref.	5	27-28 1/2
15,000	10	5/-	Do. 5% Deb. Stock, Red.	100	110-111 1/2
£290,000	2 1/2		W. African Telegraph Co., Ltd.	10	10-10 1/2
150,000	100	4%	West Coast of America, Ltd.	2 1/2	2-2 1/2
			Do. 4% Deb. Guar. by West. Tel.	100	100-102

TELEGRAPHS AND TELEPHONES.—Contd.

Present Amount Subscribed	Shares	Last Dividend	Name	Paid up	Closing Prices
88,321	10	6d.	W. India & Panama Telep. Co., Ltd., Or.	10	10 1/2-11
34,563	10	6/-	Do. 6% Cum. 1st. Pref.	10	8 1/2-9
1,669	10	6/-	Do. 6% Cum. 2nd Pref.	10	7 1/2-8
£80,000	100	5%	Do. 5% Deb.	100	100-100 1/2
207,030	10	3 1/2	Western Telegraph Co., Ltd.	10	14-14 1/2
£75,000	100	5%	Do. 5% Debts., 2nd Series, 1906	100	100-100 1/2
518,945	Stk 4%		Do. 4% Deb. Stock, Red.	100	105 1/2-104 1/2
Present Amount Subscribed	Shares	Last Dividend	Name	Paid up	Closing Prices
32,500	10	5 6	Anchor Line (Henderson Bros.), Ltd., 5% Cum. Pref.	10	10 1/2-11
£325,000	Stk 4 1/2%		Do. 4 1/2% Red. 1st Mort. Deb. Stk.	100	101-103
£672,900	Stk 4 1/2%		British & African Ste. Nav. (1900) Ltd., 4 1/2% 1st Mort. Deb. Stk. Red.	100	97-100
10,000	10	5 6	Bucknall Steamship Lines, Ltd., 5 1/2% Cum. Pref.	10	4 1/2-5
£600,000	Stk 4 1/2%		Do. 4 1/2% 1st Mort. Deb. Stk.	100	87-91
£750,000	Stk 4 1/2%		Clan Line Steamers, Ltd., 4 1/2% Deb. Stk. Red.	100	99-101
£0,000	20	16/-	Cunard Steam Ship Co., Ltd., Nos. 1-60,000	20	124-131
40,000	20	9/-	Do. Nos. 60,001-100,000	10	10 1/2-11
£464,430	Stk 4 1/2%		Elder Dempster Shipping, Ltd., 4 1/2% 1st Mort. Deb. Stk.	100	104-106 1/2
1,200,000	1	6d.	Furness, Withy & Co., Ltd., Ord.	1	1 1/2-1 3/4
25,328	7 1/2	4 1/2	Gen. Steam Navigation Co., Ltd., Ord.	7 1/2	4 1/2-5
36,758	8	4 1/2	Do. Non-Cum. 6% Pref.	8	8 1/2-9
£150,000	Stk 4%		Do. 4% 1st Mort. Deb. Stk. Red.	100	98-100
55,000	5	1 3	Houlder Line, Ltd., Ord.	5	2-2 1/2
40,000	5	2 1/2	Do. 5 1/2% Cum. Pref.	5	2 1/2-3
£200,000	Stk 4 1/2%		Do. 4 1/2% 1st Mt. Deb. Stk. Red.	100	86-88
141,500	10	5/-	Leyland (Frederk.), & Co. (1900), Ltd., 5% Cum. Pref.	10	4-4 1/2
£1,160,000	Stk 5%		Peninsular and Oriental Steam Nav. Co., 5% Cum. Pref.	100	129-131 1/2
£1,160,000	Stk 19%		Do. do. Deferred	100	132-135
15,000	100	30/-	Royal Mail Steam Packet Co. Ord.	60	10-10 1/2
39,075	5	2 6/8	Shaw, Savill & Albion, Ltd., 5% Cum. "A" Pref.	5	4 1/2-5 1/2
39,075	5	2 6/8	Do. "B" Ord.	5	4 1/2-5 1/2
141,841	10	4/-	Union Castle Mail Steamship Co., Ltd., Ord.	10	8 1/2-9
24,000	10	4 6	Do. 4 1/2% Cum. Pref.	10	10 1/2-11
£1,008,894	Stk 4%		Do. 4% Debenture Stk. Red.	100	100-102

VII.—MISCELLANEOUS COMPANIES.

Present Amount Subscribed	Shares	Last Dividend	Name	Paid up	Closing Prices
£0,000	1	9 3/4d.	Chadburn's (Ship) Tel. Co., Ltd., Ord.	1	1 1/2-1 3/4
£750,000	Stk 5%		General Hydraulic Power Co., Ltd.	100	123-128 1/2
12,500	10	10/-	Oakey (John) and Sons, Ltd., Ord.	10	24-26
10,000	10	6/-	Do. 6% Cum. Pref.	10	14 1/2-15 1/2
183,538	1	6 3/4d.	Power Gas Corp., Ltd., Ord., Nos. 66,463-250	1	4 1/2-5
66,462	1	8 1/4d.	Do. do. Nos. 1-66,462	1	4 1/2-5
145,000	1	6d.	Waygood & Co., Ltd., Ord.	1	1 1/2-1 3/4
135,000	1	7 1/2d.	Do. 7 1/2% Cum. Pref.	1	1-1 1/2

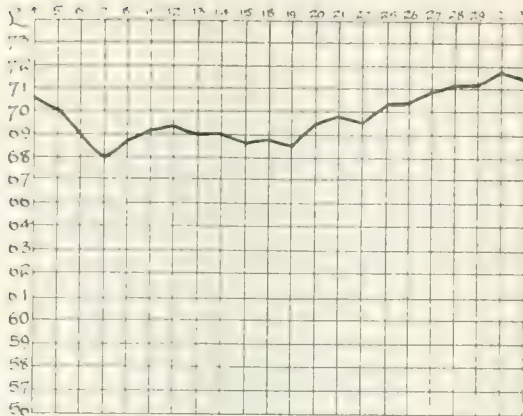
RAILWAY CARRIAGE & WAGON COMPANIES.

Present Amount Subscribed	Shares	Last Dividend	Name	Paid up	Closing Prices
10,000	10	7 1/2	Birm. Rail. & Car. Wagon Co., Ltd.	10	10-11
1-10,000	10	3 1/2	Do. 3 1/2% Cum. Pref.	10	8 1/2-9 1/2
8,730	10	3 1/2	Do. 3 1/2% Cum. Pref.	10	10 1/2-11 1/2
10,000	10	6/-	Do. 6% Cum. Pref.	10	14 1/2-15 1/2
30,111	7	7 1/2	Gloucester Rail. Car. & Wagon Co., Ltd., A, 1st Mort. Deb. Stk. Red.	7	9 1/2-10
44,889	7	4 1/2	Do. B, 2nd Mort. Deb. Stk. Red.	7	4 1/2-5
14,567	10	1 3	Lancashire Wagon, Ord.	10	10-11 1/2
1,110	10	5/-	Do. do.	10	10-11 1/2
784,808	1	9d.	Metropolitan Amalgamated Rail. Carriage & Wagon Co., Ltd., 1st Mort. Deb. Stk. Red.	1	4 1/2-5
164,288	1	6d.	Do. do. A, 1st Mort. Deb. Stk. Red.	1	1-1 1/2
245,000	1	7 1/2d.	Do. do. B, 1st Mort. Deb. Stk. Red.	1	25 1/2-29 1/2
20,000	20	20	Midland Rail. Car. & Wagon, Ltd., 5% Cum. Pref.	10	6-6 1/2

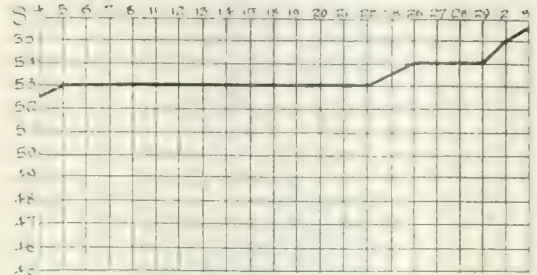
THE HOME METAL MARKET.

SHOWING DAILY FLUCTUATIONS FROM SEPTEMBER 4TH TO OCTOBER 3, 1905.

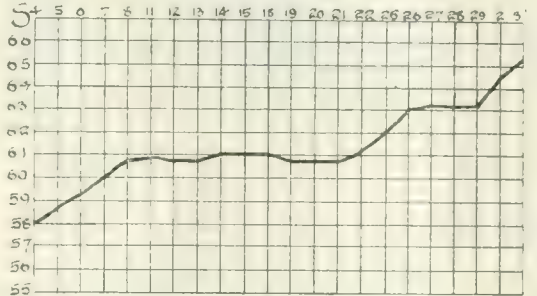
COPPER.



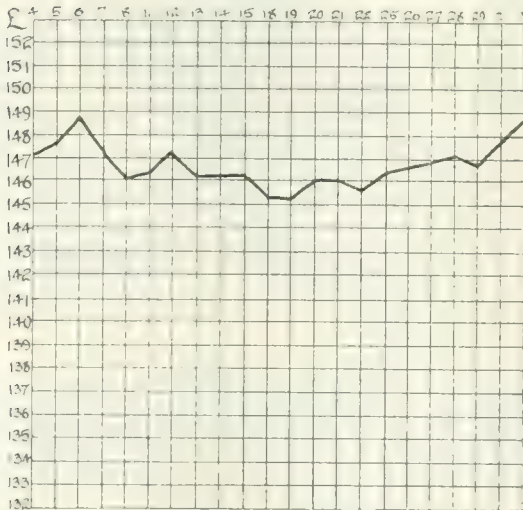
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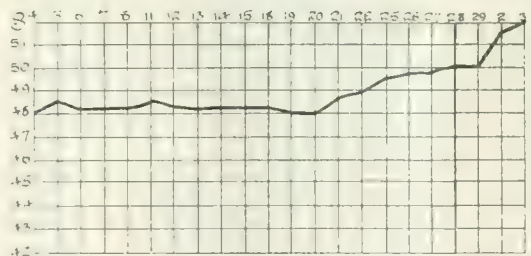
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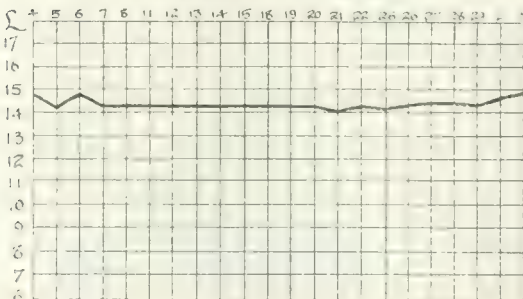
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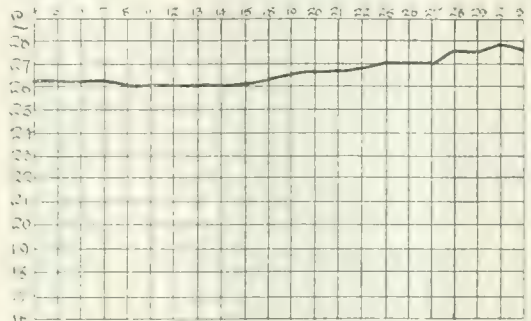
CLEVELAND.



ENGLISH LEAD.



SPELTER.



PRICES CURRENT OF COAL, IRON, STEEL, AND OTHER METALS.

MANUFACTURERS' AND MERCHANTS' QUOTATIONS.

MARKET REPORT.

Wednesday, October 4th, 1905.

UNDER the influence of satisfactory American advices Copper has been a good market at improving quotations. The comparative scarcity of supplies of refined metal has created some uneasiness among the short interest who are disposed to cover their commitments. Prices for near delivery show a considerable advance, and the latest reports indicate a strong market at £71 17s. 6d. cash and £71 three months. Messrs. Henry R. Merton and Co. give the visible supply at 16,304 tons against 15,875 tons a fortnight ago.

The Banca auction took place last week when 45,990 slabs were sold at the average price of fl.88½, equal to £148 2s. 6d. per ton. In spite of the usual market manipulation prior to the sale, quotations remained fairly steady pending the auction, and the tone has since improved on expectations of favourable statistics. There has been a certain amount of re-purchasing on behalf of the bear element, and the close to-day was firm at £149 cash and £148 three months.

Lead remains a firm market, and on the absence of fresh arrivals and a good inquiry from consumers, soft foreign prompt has rallied to £14 10s., with English quoted at £14 10s.

The position in the Spelter market is one of great strength, and with a growing scarcity of supplies and good forward buying the quotation has risen to very near record. It is difficult to see any prospect of increased production in the near future, and as producers are practically sold out for this year, the upward movement is likely to make further progress. The latest price is G.O.B. prompt £27 10s.

Favourable reports are to hand from the home centres of the iron and steel trade, and there appears to be every prospect of a further expansion of business. Not only is the position in this country a favourable one, but advices from Germany and the United States indicate a condition of real prosperity in those countries. Cleveland warrants have improved to 52s. 1d., and Standard is quoted at 50s.

IRON, STEEL, PIG- IRON, &c.

SCOTLAND.

Messrs. David Colville and Sons, Ltd., Dalzell Steel and Iron Works, Motherwell, N.B., quote as follows. Prices delivered in Glasgow or equal:—

Steel:		£	s.	d.
 Dalzell	Siemens' Steel Plates, Marine Boiler Quality ..	6	17	6
 Dalzell	" " " Land " " " "	7	12	6
 Dalzell	" " Steel Bars, Boiler Quality	7	10	0
 Dalzell	Siemens' Steel Plates, Ship Quality Plates.....	6	7	6
 Dalzell	" " Bars " " " " " " " "	7	0	0
 Dalzell	" " Angles " " " " " " " "	6	0	0

Manufactured Iron:

Bars—Dalzell	6	12	6
" Best	7	2	6
" " Horseshoe	7	2	6
" Angle.....	6	12	6
" Best Angle	7	2	6
" Best Best	7	12	6
" Extra Best	8	2	6

Usual terms and extras. Special rates for delivery in England and export. The above prices subject to alteration without notice.

The Glasgow Iron and Steel Co., Ltd., Wishaw quote as under (prices are delivered Glasgow or equal):—

(Glasgow  Steel)		£	s.	d.	
Steel Angles ..	.....	6	0	0	per ton.
Steel Ship Plates .....	.....	6	7	6	"
Steel Bars, Ship Quality .....	.....	7	0	0	"
Glasgow   Steel.					
Steel Bars, Boiler Quality .....	.....	7	10	0	"
Steel Land Boiler Plates .....	.....	6	17	6	"
Steel Marine Boiler Plates .....	.....	6	17	6	"

Less 5 per cent discount Extras as per standard list

Special prices for delivery in England and for export. The above prices subject to alteration without notice.

John Spencer (Coatbridge), Ltd., Phoenix Iron-works, Coatbridge, N.B., quote as follows.

Bars—Phoenix		£	s.	d.
Best	.....	6	15	0
Best Best	.....	7	5	0
Extra Best	.....	7	15	0
Best Horse Shoe	.....	8	5	0
Extra B.H.S.	.....	8	5	0
Extra Best Quality	.....	8	15	0
Rivet	.....	6	5	0
Best Square Rivet	.....	7	5	0

Angles—Phoenix	£	d.
Best	6	5 0
Extra Best	6	15 0
Gas Tube Hoops—Phoenix Best	6	15 0

Plates—Phoenix	—	
Best Boiler	7	10 0
Best Best Boiler	8	0 0
Extra Best Boiler	9	0 0

Boiler Tube Strips—Phoenix Best Best	8	0 0
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All per ton, delivered f.a.s. Glasgow, Greenock, Grange mouth, Granton, Leith, or Ardrossan 5 per cent discount cash monthly.

Messrs. R. Feldtmann and Co., of Glasgow, quote Commission extra)

Pig Iron :	No. 1.	No. 3.
	£ s. d.	£ s. d.
Coltuss, f.a.s. Glasgow.....	—	2 17 6
Gartsherrie.....	3 1 0	2 16 0
Summerlee.....	3 1 0	2 17 0
Carnbroe	2 17 6	2 14 6
Langloan	3 2 0	2 16 0
Calder.....	3 1 0	2 16 0
Clyde	3 0 6	2 15 6
Glengarnock, f.o.b. Ardrossan..	3 0 0	2 14 6
Eglinton	2 16 6	2 13 6
Dalmellington, „, „	—	2 13 0
Shotts	3 1 0	2 16 0

NORTH OF ENGLAND.

Messrs. W. Whitwell and Co., Ltd., Thornaby Ironworks, Stockton, quote as follows, at works:—

	£	s.	d.
W.W.  Bars	6	12	6
W.W. Best Bars	7	2	6
W.W. Best Best	7	12	6
W.W. Best Best Best	8	2	6
W.W. Best Shoe	7	2	6
Thornaby 	8	2	6
Thornaby Best	8	12	6
Thornaby Best Best	9	12	6
Whitwell Special Admiralty Cable	10	5	0
Special Chain Iron	9	5	0
Tube and Nail Strips	6	15	0
W.W.  Angle Iron	6	15	0
W.W. Best Angle Iron	7	5	0
Tee Iron, to 8 inches United.....	7	12	6

Terms, Cash, less 2½ per cent. discount on 10th of month following delivery.

LANCASHIRE.

The Pearson and Knowles Coal and Iron Company, Ltd. Dallam and Bewsey Forges, Warrington, announce that in the present uncertain state of the market, their quotations are temporarily withdrawn

WORCESTERSHIRE.

Baldwins Ltd. (with which is amalgamated Knight and Crowther, Ltd.), Wilden Works, near Stourport, quote:—

	Singles 20 G 36in. by 36in. per ton.	Doubles 21 G to 24 G 36in. by 36in. per ton.
Black Sheets	£ s. d.	£ s. d.
"Vale"	10 0 0	10 10 0
"Shield"	10 10 0	11 10 0
"Severn"	11 10 0	12 10 0
"Baldwin Wilden B."	12 10 0	13 10 0
Charcoal	16 10 0	17 10 0
Best Charcoal	18 10 0	19 10 0

Pickled, cold-rolled and close annealed sheets specially quoted for.

Extra widths, Singles to 66in., Doubles to 56in., Lattens to 46in. Extra lengths, Singles to 168in., Doubles to 132in., Lattens to 108in.

Patent Coated Sheets:

	£	s.	d.	£	s.	d.
No. 3 Lead.....	13	10	0	14	10	0
S.V. Lead	15	0	0	16	0	0
No. 3 Terne	15	0	0	16	0	0
S.V. Terne.....	16	10	0	17	10	0

Tinned Sheets:

	£	s.	d.	£	s.	d.
Best Coke (Finish)	29	0	0	30	10	0
Charcoal (Finish)	31	0	0	32	10	0
Extra	33	0	0	34	10	0

Cotton Can Tin Sheets to 39in. by 36in. specially quoted for. Tin Plates, "Cookley, K" Best Charcoal, £1 7s. 0d. per box. Extreme sizes in Tin and Patent Coated specially quoted for. Lattens up to 36 wide by 27 W.G. £1 10s. 0d. per ton extra throughout for all brands. At works.

Galvanized Corrugated Sheets:

"Phoenix" Brand, 24 G., f.o.b. London, in Bundles	£	s.	d.
"Blackwall" Brand, 26 G., in felt-lined cases for Australia, f.o.b. London..	15	0	0

Galvanized Working Up-Sheets:

24 G., f.o.b. London, in Bundles	£	s.	d.
	13	10	0

STAFFORDSHIRE.

Shelton Iron, Steel, and Coal Co., Ltd., Stoke-on-Trent, North Staffordshire, and 122, Cannon Street, London, quote:—

	£	s.	d.
Crown Bars.....	6	15	0
Best Bars (1 to 6in. wide, above ½ in. thick, ½ in. to 4 rounds and squares)	7	5	0
Angles	7	0	0
Best	7	10	0
T's	7	5	0
Best	7	15	0
Best Shoe Iron	8	5	0
Rivet Iron	8	5	0
Best Rivet (Special)	9	10	0
Cable	9	10	0
Screwing	9	10	0

	£	s.	d.	
Best Turning	8	5	0	per ton
.. Plating	8	10	0	..
Best Best	9	10	0	..
Treble Best	10	10	0	..
Plates	7	15	0	..
Best Plates	8	5	0	..
.. Boiler Plates	8	15	0	..
.. Best Boiler Plates	9	15	0	..
Treble Best Boiler Plates	12	5	0	..

Delivery f.o.b. Liverpool, Birkenhead or Manchester.

WALES.

Cordes (Dos Works), Ltd., of Newport, Mon.,
quote "Star" brand patent wrought nails steel nails, &c.

Discounts—

45 per cent. off 1-inch to 3-inch strong rose and all fine rose and 8dy. and 8dy. pound.

40 per cent. off 3½-inch to 7 inch strong rose and 10dy. and 20dy. pound.

40 per cent. off all sharp-pointed nails.

Delivered in lots of 4 cwt. and upwards. Extra 2½ per cent. discount off the gross on two tons and upwards.

Steel rose, flat points, 5-inch to 7-inch basis:—

2 tons 9/9 per cwt.

4 cwt. lots and upwards 10/ per cwt. d/d any Railway Station

Steel cut nails, 3-inch basis—

2 tons 8/6 per cwt.

4 cwt. lots 8/9 per cwt. d/d any Railway Station.

Slit rods (iron) £7 10s. per ton, at works for 2-ton lots.

Messrs. Richard Thomas and Co., Ltd., of 33 and 35, Eastcheap, E.C. — Works: South Wales, Burry, Lydney, Lydbrook, and Cwmbwrla,
quote:—

	Per Box.	f.o.b.	Wales.
	£	s.	d.
Coke Tin-plates.			
C 18½ by 14 124s. 110 lb. "BV"	0	12	¼
C 20 by 10 225s. 155 " " Jumbo "	0	17	¼
C 20 by 14 112s. 108 " " Lydbrook "	0	12	0
C 28 by 20 112s. 216 " " Lydbrook "	1	4	3

Charcoal Tinplates:

C 20 by 14 112- 108 lb. "Allaway"	0	12	9
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BELGIUM.

C. L. Faulkner, Suffolk House, Laurence Pountney Hill, London, E.C., quotes:—

Prices quoted are in £ stg. and per ton of 1,015 kos. (2,240 lb.) delivered free on board ANTWERP for approved quantities.

Steel:	£	s.	d.	
Blooms	at 3	16	0	per ton.
Billets	at 3	18	0	..
Sheet Bars	at 4	0	0	..

Finished Steel:

Bars	at 5	2	0	per ton.
Angles	at 5	3	0	..
Tees	at 5	5	0	..
Joists	at 4	12	6	..
Fencing Standards	at 5	4	0	..
Shoeing Bars	at 5	5	0	..
Tyre Bars	at 5	5	0	..
Half-Round Bars	at 5	10	0	..
Heavy Rails	at 5	5	0	..
Light Rails	at 4	17	6	..

Structural Steelwork:

Prices on application.

METALS.

Messrs. French and Smith, 147, Leadenhall Street, and 11, Oldhall Street, Liverpool, quote:—

TIN.

Tin:	£	s.	d.	£	s.	d.	
English Ingots, f.o.b.							
Dis. 1½% & 1%	149	0	0	to	149	10	0 per ton
English Bars, f.o.b.							
Dis. 1½% & 1%	150	0	0	to	150	10	0 ..
Straits G.M.B., cash							
Warehouse, Net	148	15	0	to	148	17	6 ..
Straits G.M.B., 3 months,							
Warehouse, Net	147	15	0	to	147	17	6 ..
Australian, Mt. Bischoff,							
Warehouse, Net	149	0	0	to	149	5	0 ..

COPPER

Copper:	£	s.	d.	£	s.	d.	
Standard G.M.B., cash							
Warehouse, Net	71	15	0	to	72	0	0 per ton.
Standard G.M.B., 3 months, Warehouse, Net	70	17	6	to	71	0	0 ..
English, Tough, Cake & Ingot, Warehouses, Net	76	0	0	to	76	10	0 ..
English, Best Select, Warehouse Net	77	0	0	to	77	10	0 ..
English, Sheets and Sheathing, f.o.b., Dis. 2½%	83	0	0	to	84	0	0 ..
English, Sheets for India, f.o.b., Dis. 2½%	79	0	0	to	79	10	0 ..
Electro, Warehouse, Net	76	5	0	to	76	10	0 ..
Ore, ex ship	0	13	6	to	0	14	6 per unit
Regulus, Matte and Precipitate, ex ship, ...	0	14	6	to	0	15	0 ..

YELLOW METAL.

Yellow Metal:	£	s.	d.	
Sheets, 4 by 4 feet for India f.o.b. Dis. 2½%		0	0	6½ per lb.
Sheathing " "		0	0	6½ "

SPELTER

	£	s.	d.	£	s.	d.	
Silesian outports, Net	27	10	0	to	27	12	6 per ton.
Blende of 50% Net	6	15	0	to	7	7	6 ..
Calamine, Net	6	17	6	to	7	10	0 ..

LEAD

	£	s.	d.	£	s.	d.	
English Pig, Warehouse, Dis. 2½%	14	12	6	to	14	15	0 per ton.
Spanish, ex ship, Dis. 2½%	14	7	6	to	14	10	0 ..
Lead Ore of 70% Net	7	7	6	to	7	12	6 ..

ANTIMONY.

	£	s.	d.	£	s.	d.	
Star Regulus, f.o.b., Dis. 2½%	34	10	0	to	35	0	0 per ton.
Ore, 50%, ex ship, Dis. 2½%	15	10	0	to	16	0	0 ..
Crude, ex ship, Dis. 2½%	34	0	0	to	36	0	0 ..

QUICKSILVER.

	£	s.	d.	
Spanish, 75% Warehouse, Net	7	0	0	per flask
Italian	7	0	0	..

CHEMICALS.

Messrs. S. W. Royse and Co., Albert Square,
Manchester, quote :

Upper Main Seam.

Upper Main Seam.		S. d.
Main Coal.....		6 0
Best Hard Steam (hand picked, as used by the Railway Companies)		5 6
Best Hard Steam Cobbles (made through 6 in. mesh, free from slack)		5 6
Fine Slack		1 0
Terms, net cash on 10th of month following delivery.		

The Manners Colliery Co., Ltd., of Ilkeston
quote as follows, per ton at pit:

Kilburn Coal :	s.	d.
Best London Brights	9	9
Large Nuts ($1\frac{1}{2}$ to $3\frac{1}{4}$)	9	6
Small Nuts ($\frac{3}{4}$ to $1\frac{1}{4}$)	6	0
Rough Brights	6	0
Peas ($\frac{3}{8}$ to $\frac{3}{4}$)	5	0
Slack	3	6
Smudge	2	0

Low Main Brights	7	6
" " Nuts	7	3
Hards (Good Steam Coal)	8	0
Bakers' Nuts (1 st to 2 nd)	6	6
Slack	3	6

	per ton at pit.
	s. d.
Best Main Coal.....	10 6
Best Silkstone.....	10 0
Best House Coal.....	8 6
Best House Nuts.....	8 0
Treble Screened Cobbles.....	7 9
Best Cobbles.....	7 3

The Digby Colliery Co., Ltd., near Nottingham,
quote per ton at pit :—

STEAM.	s.	d.
Best Hand Picked Hard	8	6
Steam Hard	7	3
Hard Nuts	6	6

London Brights, 4 to 8 in. cube	10	6
Bright Colours (Hand Picked)	10	0
Large Nuts, 2 to 4 in. cube	9	6
Small Nuts, 1 to 2 in. cube	6	0
Per Nut 2 to 1 lb. cube	5	0

Best Hard	8	6
Hard Stems	7	6
Cobbles	6	3

	£	s.	d.	
Acids: Oxalic	0	0	2½	per lb.
Picric, Crystals	0	0	10	"
Tartaric at Manchester ...	0	0	10½	"

	£	s.	d.	
Acetate of Lime: Brown at Manchester net	8	10	0	per ton.
" Grey	11	15	0	"
Alumina: Alum, Lump, loose.....	5	5	0	"
" " in casks	5	7	6	"
" Ground, in bags	5	15	0	"
Sulphate of Alumina, 14%	4	10	0	"

Ammonia : Carbonate	0	9	3½	per lb.
Muriate Grey f.o.b. Liverpool	24	10	0	per ton.
Sal-ammoniac, Lump, 1sts, del ^d . U.K.	42	0	0	..
2nd ^s	40	0	0	..
Sulphate	12	17	6	..
f.o.b. Liverpool	14	10	0	..
Arsenic : Best White Powdered	14	10	0	..
Bleaching Powder , 35%	4	7	6	..
Borax : British Refined Crystal	13	0	0	..

Benzole, 50 90° ..	0 0	84 per gal.
" 90° ..	0 0	9 " "
Carbolic Acid Crystals, 34 35° C.	0 0	5½ per lb.
" " 39/40° C.	0 0	6 " "
" " Liquid, 97 99 % ..	0 0	9 per gal.
" " Crude, 62½° at 60° F.		
f.o.b. ..	0 1	7 " "
Cresote, ordinary good liquid.....	0 0	1 " "
Naphtha, Crude, 20 % at 120° C.	0 0	3 " "
" Solvent, 90% at 160° C.f.o.b.	0 0	9½ " "
" " 95 % at 160° C. " "	0 0	10 " "
" " 90 % at 190° C. " "	0 0	11½ " "
" Rectified, flash point over 73° F. f.o.b. ..	0 0	11 " "
" Rectified, flash point over 100° F. f.o.b. ..	0 1	0 " "
Naphthalene, all qualities.		

Pitch.....	f.a.s. Manchester.	„	1	8	0	per ton.
Copperas : Green, in bulk		„	0	12	6	„
„ barrels f.o.b. L'pool		„	1	18	6	„
„ Cake.....		„	1	1	6	„
Copper : Sulphate.....			21	15	0	„

Cyanides: 98% minimum f.o.b. net 0 0 7½ per lb.

Lead : Acetate (Sugar) White, English.....	27	10	0	per ton.
" " " Foreign c.i.f. U.K.	23	15	0	"
" " " Grey	21	15	0	"
" " " Brown at Manchester	17	5	0	"
Nitrate	25	0	0	"
Litharge, Flake	16	10	0	"
" " Powder	17	0	0	"
Red Lead, Genuine, c.i.f. London				
less 5%	16	0	0	"
White " " Dry " " "	17	0	0	"

Naphtha (Wood): Miscible, 60 o.p.	0	2	6	per gal.
Solvent.....	0	2	7	„

Potash : Bichromate... delivered England...	0	0	3	per lb
Carbonate, 90/92 % ... c.i.f Hull...	17	15	0	per ton.
Caustic, 75/80 %	19	5	0	„
Chlorate	net	0	0	3 ¹ / ₁₆ per lb.
Montreal.....in Store, Liverpool	31	0	0	per ton.
Prussiate Yellow	net	0	0	4 ¹ / ₂ per lb.

	£	s.	d.	
Soda: Ash, Caustic, 48 " Ordinary	net	5	5	0 per ton.
" " " " Refined	"	6	5	0 "
" Carbonated, 48 " "	"	5	10	0 "
" " " " (Ammonia Alkali)	net	4	10	0 "
" Bleachers' Refined Caustic	"			
50, 52 " "	net	6	10	0 "
Caustic, White, 77 %	"	10	12	6 "
" " 70 %	"	9	12	6 "
" " 60 %	"	8	12	6 "
" Cream, 60 %	"	8	10	0 "
Crystals, in bags	"	3	0	0 "
" barrels	"	3	7	6 "
Acetate	c.i.f. Hull net	16	10	0 "
Bicarbonate, in 1 cwt. kegs.	"	6	15	0 "
Bichromate, delivered England	"	0	0	2½ per lb.
Chlorate	net	0	0	3¾ per lb.
Nitrate, ex quay Liverpool, ..	"	10	10	0 per ton.
Phosphate	"	9	5	0 "
Prussiate	net	0	0	3½ per lb.
Silicate, Solution, 140° Tw.	"	4	10	0 per ton.
Sulphate (Glauber Salts)	"	1	10	0 "
" (Salteake, 95%)	"	1	15	0 "
Sulphur: Recovered	"	4	15	0 "
Roll	"	6	15	0 "
Flowers	"	7	10	0 "
Zinc: Sulphate	"	6	15	0 "
Shellac: Standard TN orange spot	"	9	0	0 per cwt.

MINERALS.

Messrs. S. W. Royse and Co., quote:—

	£	s.	d.	
Barytes: Lump Carbonate, 90/92% ..	3	10	0	per ton.
Sulphate, No. 1, White ..	2	15	0	"
China Clay: of various qualities for all purposes; prices from about 11/- to about 30/- per ton, f.o.b. Cornwall: stocks also kept at Runcorn and Preston. Quotations given carriage paid.				
Chrome Ore: Basis 50% c.i.f. British Ports ..	3	10	0	"
Manganese: Lump c.i.f. Liverpool 10½d. per metallic unit.				
Ochre: French JC .. f.o.b. Rouen, net	2	5	0	per ton.
" JF ..	5	10	0	"
Talc: (French Chalk) .. c.i.f. Liverpool	3	10	0	"

Messrs. Henry Bath and Son, quote:—

	£	s.	d.	
Copper, Ores of, 10 to 25% ..	0	12	0	to 0 13 0 per unit.
Regulus, 45 to 55% ..	0	13	3	to 0 13 9 "
Precipitate, 65 to 80% ..	0	13	4½	to 0 13 10 "
Tin Ores, 70% ..	0	1	0	to 0 3 0 per ton.
Lead Ore, 70% ..	6	19	0	"
Blende, 50% ..	6	9	6	"
Calamine ..	6	12	0	"
Antimony Ore, 50% ..	20	0	0	to 22 0 0 "

Messrs. Barrington and Holt, Cartagena, quote:—

Iron Ore

	s.	d.	
Ord. 50%, .. f.o.b. Porman ..	6	4	per ton.
Do .. Cartagena ..	6	7	"
Special low phos. .. Porman ..	6	10	"
Do .. Cartagena ..	7	8	"
Extra quality do. ..	7	6	"
Special Iron Ore ..	nominal		"
Specular 58% do. ..	10	9	"

TIMBER.

Messrs. Alfred Dobell and Co., Liverpool, quote:—

COLONIAL WOODS.

Timber.

	£	s.	d.	
Quebec Square White Pine... per cub. ft.	0	1	9	to 0 3 3
Quebec Waney Board Pine...	0	2	8	0 3 9
St. John Pine, 18 in. average	0	2	4	0 3 3
Lower Ports Pine.....	0	1	3	0 1 8
Quebec Red Pine	0	1	6	0 2 3
Quebec Oak, 1st quality	0	2	9	0 3 4
Quebec Oak, 2nd quality ...	0	1	6	0 2 6
Ash ..	0	1	6	0 2 3
Elm ..	0	3	3	0 4 0
Hickory ..	0	2	0	0 2 6
Quebec Birch ..	0	1	6	0 2 3
St. John Birch ..	0	1	6	0 2 0
Birch Planks ..	0	0	9	0 0 11
Spruce Spars ..	0	0	10	0 1 0

Deals.

1st quality Quebec Pine	per std.	22	10	0	to 32	10	0
2nd do. do.		17	0	0	22	0	0
3rd do. do.		11	10	0	13	0	0
St. John, Miramichi, etc., Spruce ..		7	5	0	7	10	0
Nova Scotia Spruce ..		7	2	6	7	7	6

Spruce Boards

9 7 0 6 12 6

UNITED STATES, etc., WOODS.

Pitch Pine.

	£	s.	d.	
Hewn .. per cub. ft.	0	1	4	to 0 1 8
Sawn ..	0	1	0	0 1 6
Planks, Stowage ..	0	0	10	0 1 0
Boards, Prime .. per std.	12	10	0	16 0 0

Oak Timber .. per cub. ft. 0 1 6 0 2 6

Oak Planks .. 0 1 6 0 2 1

East India Teak .. per cub. ft. 0 0 16 0 0

Greenheart .. 6 15 0 7 10 0

EUROPEAN WOODS.

Timber.

	£	s.	d.	
Riga Redwood .. per cub. ft.	0	1	6	to 0 2 0
Dantzie and Memel Fir ..				
Crown ..	0	2	1	0 2 6
Dantzie and Memel Fir ..				
Middling ..	0	1	9	0 1 11
Stettin ..	0	1	9	0 1 11
Swedish ..	0	1	0	0 1 3
Riga Whitewood ..	0	1	0	0 1 3
Norway Mining Timber ..	0	0	9	0 1 0
Dantzie and Stettin, etc., Oak ..	0	2	6	0 3 0

Norway Spars. .. 0 1 2 0 1 9

Deals.

Red Archangel and Onega ..	per std.	10	0	0	20	0	0
1st quality ..							
Red Archangel and Onega, 2nd quality ..		14	0	0	16	0	0
Red Archangel and Onega, 3rd quality ..		10	10	0	12	10	0
St. Petersburg, 1st quality ..		16	0	0	17	10	0
Do. 2nd ..		14	0	0	15	0	0
Gedle ..		11	10	0	16	0	0
Wyburg ..		11	0	0	12	10	0
Ulsburg ..		10	0	0	12	10	0
Gothenburg ..		1	0	0	16	0	0

SELECTED PATENTS.

Compiled expressly for this journal by **Messrs. Page and Rowlingson, Engineering Patent Agents, 26, New Bridge Street, London, E.C.,** and at Manchester.

Copies of Specifications may be obtained at the Patent Office Sale Branch, 25, Southampton Buildings, Chancery Lane, W.C., at the uniform price of 8d.

NEW PATENTS APPLIED FOR.

When patents have been communicated the names of the communicators are printed in *italics*.

18784. F. J. Mallett, Bristol. Sept. 18th.—An improved variable gear pulley for belt-driven automobiles.

18801. Humber, Ltd., and F. Easom, London. Sept. 18th.—Improvements in variable-speed gearing for velocipedes or the like.

18811. P. Browne, London. Sept. 18th.—Speed-change gearing.

18827. Saunders' Patent Launch Building Syndicate, Ltd., and S. E. Saunders, London. Sept. 18th.—Improvements in or connected with internal combustion engines.

18832. L. Macquaire, France. Sept. 18th.—Improvements in or relating to sparking plugs for internal combustion engines.

18856. A. Sharratt, Halifax. Sept. 19th.—Improvements in brickmaking machines.

18857. S. Brockwell, Burton-on-Trent. Sept. 19th.—A perforated smoke-consuming bridge for steam or water boiler.

18879. J. Straka, Birmingham. Sept. 19th.—An improved rotary motor.

18899. M. J. D. Carter, London. Sept. 19th.—Improvements in rotary duplicators.

18908. F. Hodgkinson, The Westinghouse Patent Bureau, London. Sept. 19th.—Improvements in elastic fluid turbines. (Date applied for, Sept. 30th, 1904.)

18912. W. M. Hoffman, London. Sept. 19th.—Improvements in rotary engines.

18923. R. Reid, London. Sept. 19th.—Improvements in apparatus for generating gas or steam and usable also for heating purposes.

18930 H. G. Boyd, and W. R. McKay, London. Sept. 19th.—An improved motive fluid and means for generating the same.

18957. J. L. Berry, and A. W. Taylor, Manchester. Sept. 20th.—Improvements in pulsating steam pumps.

18968. J. Duthie, Aberdeenshire. Sept. 20th.—Improved through ship's shell riveting.

19024. R. Nass, London. Sept. 20th.—Improvements in rotary steam engines.

19038. N. R. Stiles, London. Sept. 20th.—Improvements relating to change-speed gears.

19051. J. Wishart, Liverpool. Sept. 21st.—A reversing rotary expansion steam or other gas engines.

19092. B. O. Wagner, London. Sept. 21st.—Improvements in reciprocating electric engines. (Date applied for Sept. 22nd, 1904.)

19107. O. Flamm, and F. Romberg, London. Sept. 21st.—Improvements in water-tube boilers.

19109. A. Separation and A. J. Ericsson, London. Sept. 21st.—Improvement in or relating to centrifugal separating apparatus.

19115. G. Rozieres, London. Sept. 21st.—Improvements in means for controlling the pressure of the compressed motive fluid. (Date applied for Sept. 21st, 1904.)

19127. R. P. M. Nickols, and C. H. Brown, London. Sept. 21st.—Improvements in reciprocating engines.

19129. R. H. N. Lindley, and J. B. King, London. Sept. 21st.—Improvements in sparking plugs or internal combustion engines.

19147. T. Downe, Liverpool. Sept. 22nd.—Improvements in metallic lift valves.

19174. T. S. James, London. Sept. 22nd.—Improvements in internal combustion engines.

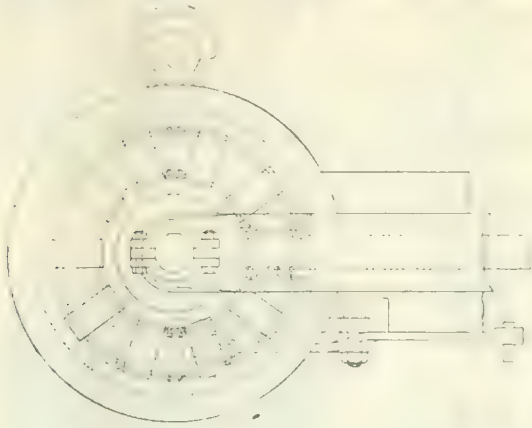
19183. H. L. Davies, London. Sept. 22nd.—Improvements in steam generators.

RECENT SPECIFICATIONS.

AN IMPROVED MACHINE OR APPARATUS FOR THE MANUFACTURE OF BRIQUETTES AND THE LIKE ARTICLES MOULDED BY PRESSURE

J. H. Pease, Darlington, and Normanby Iron Works Company, Ltd., Middlesbrough. August 24th, 1905. A machine or apparatus of the kind to which this invention is applicable consists of a revolving table comprising a series of moulds arranged in circular succession and adapted to support as many plungers as there are moulds in the table. When the plungers having an all-round plain fit between itself and the moulds is brought into action by running upon a fixed race, it is found in practice that excessive friction is set up to overcome which the plungers have been supported in the moulds themselves by an enlarged plunger head finding a seat on a ledge formed by a step in the mould, with the result that the material under treatment finds its way between the two and causes choking in the mould, and in the manufacture of briquettes for the blast furnace from purple ore the plungers have to be withdrawn and cleaned as often as twice a day, and undue wear also exists between the plunger-head and the seat. The object of this invention is to obviate these defects and to overcome the tendency to choking between the plunger and

mould. In the accompanying drawing is a plan view of a briquetting machine embodying the improvements of this invention and shows a revolving table which is driven in the usual manner by a tappet



pinion. This table comprises a series of moulds, into each of which is placed a plunger supported by an inner and outer edge or ring, forming between them an annular space below the moulds, which ledges or rings are secured to the underside of the table by means of studs or screwed spindles, thus forming an open framework for supporting the plungers in direct line with the moulds. When the moulds are filled with the material to be pressed into briquettes, the pressure is applied to the plungers in turn by a compressing block actuated by a lever; after which the briquettes are pushed out of the moulds by a pushing-out block, actuated by another lever, which is furnished with a pin to engage with a cam on the machine in the usual manner.

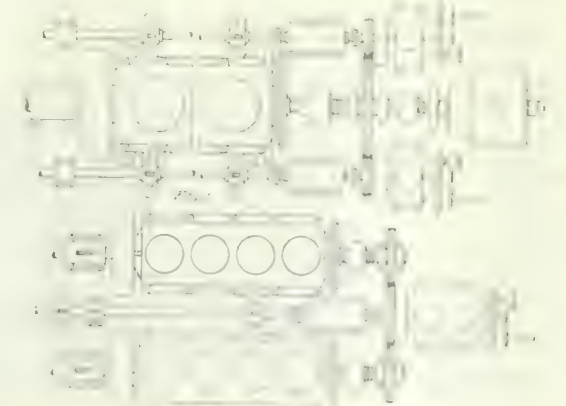
The inner and outer rings are conveniently made up in halves and jointed together as shown, which halves can be readily disconnected by taking out the bolts, thus allowing the plungers to drop out of the table when required for cleaning or repairing purposes. As the plungers work in an open space below the table, the result is that any material finding its way past the head of the plunger, instead of choking the machine, is free to pass down the sides thereof, and to fall between the supporting ledges, especially when the plunger is lifted clear of them.

NOVEL OR IMPROVED MEANS FOR PROPELLING SHIPS BOATS AND OTHER CRAFT, BY INTERNAL COMBUSTION.

The Wolseley Tool and Motor-car Company, Ltd., and H. Austin, Birmingham.

August 31st, 1903. This invention relates to the propelling of ships and other craft by means of internal combustion engines, and has for its object to facilitate the starting of the engine of a main central propeller, or the engines of main twin propellers, and to adapt means used for such first-mentioned purpose to drive either or both of a pair of auxiliary twin propellers, and, either both forward or reverse, or one of them forwards and the other reverse, and at the same or different speeds, as at any time required, whereby such auxiliary twin propellers may be utilised in driving or reverting or in steering, as required, or to adapt such means to drive a single auxiliary propeller, having its axis somewhat to the side of the main

propeller, either forwards or reverse as desired, and to adapt means used for such second-mentioned purpose to driving a central auxiliary propeller, either forwards or reverse as desired. Fig. 1 of the accompanying drawings is a plan view of the invention as adapted for use in connection with a main central propeller. For convenience of illustration this view is shown as if portions were broken away from the middle of the main engines, and from the middles of the auxiliary propeller shafts. Fig. 3 is a plan view as adapted for use in connection with main twin propellers. Fig. 1 illustrates the shaft of an internal combustion engine which drives the central main propeller, the cylinders of such engine mounted on a box-bed, the shafts of auxiliary twin propellers which pass along at opposite sides of the axis of the main shaft, and auxiliary internal combustion engines which are geared with the auxiliary propeller shafts respectively, through the medium of gear-boxes, in a manner as will be readily understood, which enables each of them, though itself adapted to run in one direction of rotation only, to drive the corresponding shaft forwards or reverse, as desired, or to be thrown out of gear therewith. On each auxiliary engine-shaft is mounted a pinion, and on a shaft which is in alignment with the main shaft is mounted a gear wheel with which both the pinions are constantly in mesh. The main shaft is normally in clutch with this shaft through the medium of a friction clutch, and the interlocking of the pinions with their shafts may, if desired, be by means of clutches so as to enable them, or either of them to be thrown out of clutch therewith. To start the main engine, the auxiliary engines are first started, while the main engine shaft is out of clutch with the shaft which is in alignment with it, and, consequently free in relation to the gear wheel, and then the main shaft is clutched to the aforesaid shaft and is consequently set in motion by the auxiliary engines. A dynamo-electric machine having its axis conveniently in alignment with the shaft on which the gear wheel is mounted, capable of being engaged with or disengaged from the shaft at will, such as through the medium of a friction clutch, may be driven by the auxiliary engines, for the purpose of charging accumulators, or for any other desired purpose, and this dynamo may be utilised if desired



as an electric motor to start the auxiliary engines. In a modified form (fig. 3) a single auxiliary engine is used in place of the two auxiliary engines, and a single auxiliary propeller and engine are used in lieu of the two auxiliary propellers and engines.

NEW PUBLICATIONS.

"WORKSHOP COSTS FOR ENGINEERS AND MANUFACTURERS."

By Sinclair Pirrie and Frank Pirrie. Technical Publishing Company, 1005 Colburn.

This is a book which ought to find a place in the offices of every workshop for which it is sold, fully with the detail and routine of a systematic and the production of engineering work. It is obvious that for a system and method can be applied more readily to other businesses. As to the importance of systemisation there is little need to write. Always an important factor in the economical production of work, it has become an absolute necessity to-day. It is more than ever needful that a manufacturer should employ some method of ascertaining the true cost both in detail and in bulk of all material and of the operations performed thereon. An efficient cost system founded on such a nature that its working can be readily grasped by the average clerk or workman, and easily adaptable at the commencement of any contract, and the claim for the system illustrated and described in this book that it is of the greatest assistance in the economical control of work and of labour will be admitted by those who have had experience of this particular scheme. This second edition has been issued in reply to the request for a less expensive work than the original production, although, at the same time, the whole of the literary and other matter is left intact as it appeared in the first edition. The book is divided into five parts, dealing successively with the nomenclature and registration of patterns and materials; the recording and analysis of labour; manufacture or repetition work; the stores and assembly work; and contract or special work. Its publication in this cheaper form is likely to lead to a large demand from manufacturers and business men.

"AN INTRODUCTION TO THE INFINITESIMAL CALCULUS."

Notes for the use of science and engineering students. By H. S. Carslaw, M.A., D.Sc., F.R.S.E. Longmans, Green and Co. 5s. net.

These introductory chapters in the Infinitesimal Calculus were originally issued to the first year students in the science and engineering section of the Sydney University. They form an outline of, and, says Dr. Carslaw, were meant to be used in conjunction with, the course on the elements of analytical geometry and the infinitesimal calculus, which leads up to a term's work on elementary dynamics. The author's object has been to present the fundamental ideas of the calculus in a simple manner and to illustrate them by practical examples and thus enable young students to use its methods readily in their geometrical, dynamical and physical work during the university training. The following is a brief synopsis of the treatise: co-ordinate geometry; the meaning of differentiation; differentiation of algebraic functions; some general theorems in differentiation; the differentiation of the trigonometric function; the exponential and logarithmic functions; maxima and minima; partial differentiations; the conic sections; the integral calculus; integration and the definite integral and its applications.

BOOKS RECEIVED.

"Life as an Engineer: its lights, shades and prospects." By J. W. C. Haldane, M.I.Mech.E. E. and F. N. Spon.

"Work." The illustrated weekly journal of handicrafts. Vol. XXIX. Cassell and Co.

NEW CATALOGUES.

Wallach Brothers, 57, Gracechurch Street, E.C. Very handy are many of the appliances described and illustrated in this firm's 1905 novelty list, commencing with "Omnidrill" portable electric drilling machines (which can be had for either hand or bench work), and concluding with an account of the "W.B." sand-blast machine. The other appliances dealt with include alcohol blow-pipes, adjustable gasoline forges, flue welding and other furnaces, central gear grinders, spraying machines, hot blast-brazers, the "W.B." light locomotive fire kindlers, tyre expanders, etc. The list should be of interest in any workshop.

Herbert Morris and Bastert, Ltd., Loughborough. Book 41 has been issued by the firm with a view to showing the great differences there are between a really good pulley-block and the ordinary trade article. It is pointed out that "there is so much inferior lifting-tackle in use in various shops as to be a source of grave annoyance and danger, and, although made by reputable makers, it behoves each user to look into the safety of his tackle himself, irrespective of any representations which may have been made to him as to test-loads or such 'like.'" An invitation is given to engineers to calculate some of the breaking-strains in the firm's pulley-blocks, and it is suggested that some of the results will, in the words of Shakespeare, "give them pause."

Rimington Bros., Carlisle and London. The all-important question of lubrication and lubricators is dealt with in a fully-illustrated pamphlet issued by the above firm. The pamphlet covers the following ground: Oil as a lubricant, steam cylinder oil, oil for superheated steam, forced lubrication, positive lubrication, Manzel's force and sight-feed oil pump, Werder graphite and oil pump, the Hansa graphite lubricator, cylinder lubricators, tallow cups, oil syphons, etc., sight feed oilers, oil to specification, oiling devices, oil v. grease as a lubricant, scientific oiling, selections from "How to oil an engine," oiling systems, manifold oiling devices, force feed oilers, sight feeds for oiling systems, oil pumps for oiling systems, shafting lubricators, grease lubricators, lubricative steam packing, cylinder oils, lubricating oils, self-lubricative shaft hangers, specific gravities of oils, table of oil calculations, and the Armstrong oiler.

Bertrams Ltd., Sciennes, Edinburgh. A fully-illustrated catalogue of floor-cloth and linoleum mill machinery has been issued by the above firm. The machinery in question includes oil boilers for oxidising plant, oil pump; fittings for oxidising sheds, cement mixing pans, resin disintegrators, skin mills, hot backing pans, steam-jacketed resin dissolving pans, hand and power winches, cork breakers, bucket elevators, sand removers, cork mills, horizontal and vertical conveyors, cork dressing machines, German mixers, powerful calendars, hoists, scrap rolls, choppers, trolleys, trowelling machines, backing machines, portable beaming machines, trimming machines, measuring machines, drying stoves, varnishing machines, flat printing machines, paint plant, grinding mills, and pug mills.

Another pamphlet from the same firm presents a series of illustrations of condensing plant for turbines and reciprocating engines as supplied by Bertrams, Ltd., to corporations, power stations, etc. A third series of illustrations reminds us that the firm also specialise on Rubber Mill Machinery.

PAGE'S WEEKLY

Miscellaneous

OLYMPIA, Stand 72.

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Semi-Enclosed Type.

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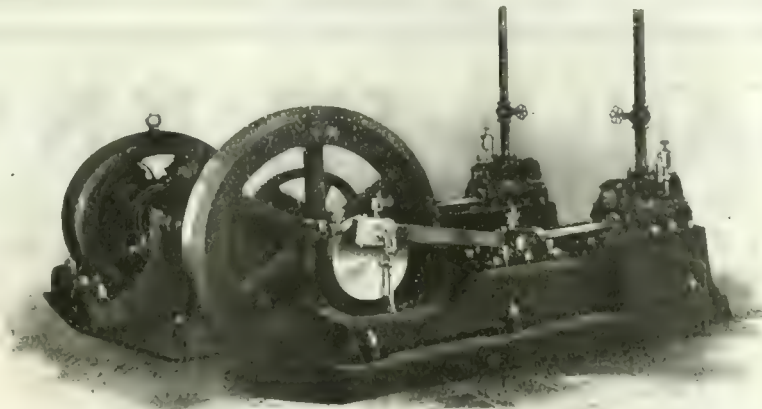
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PAGE'S WEEKLY

Locomotives, &c.

McLAREN'S Steam Ploughs AND TRACTION ENGINES.

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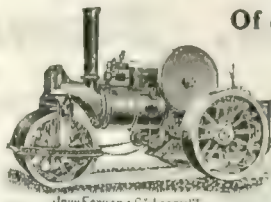
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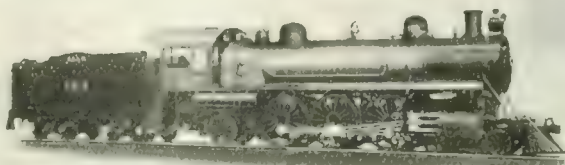
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Electric Trucks.

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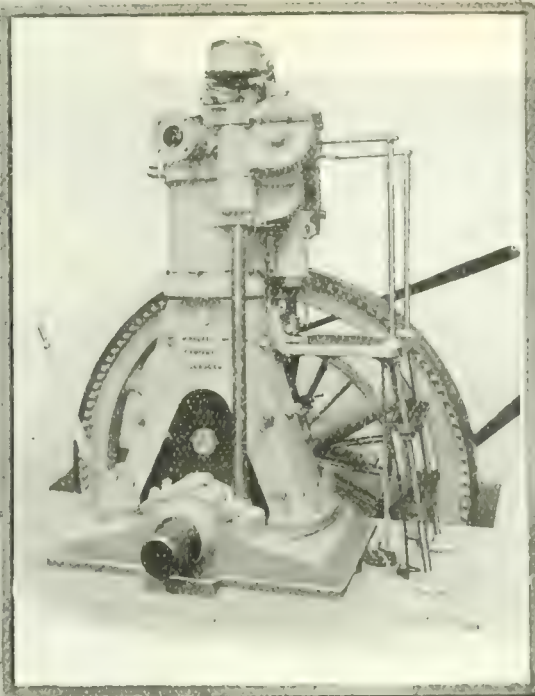
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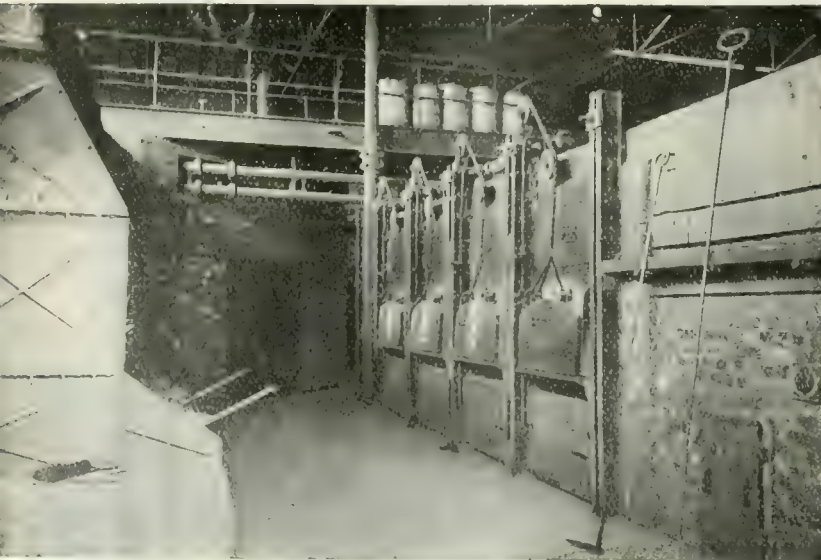
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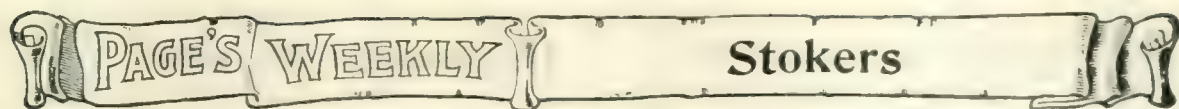
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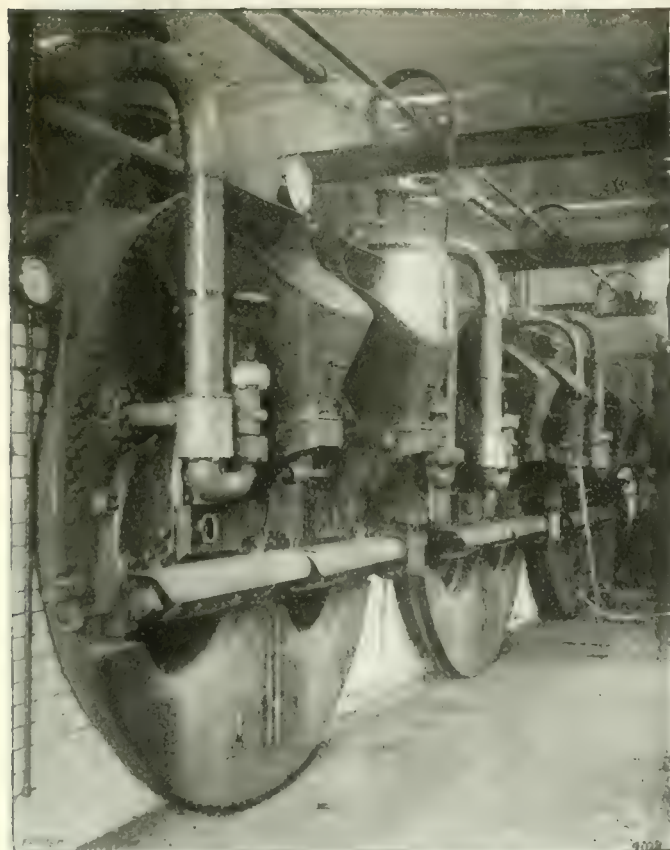
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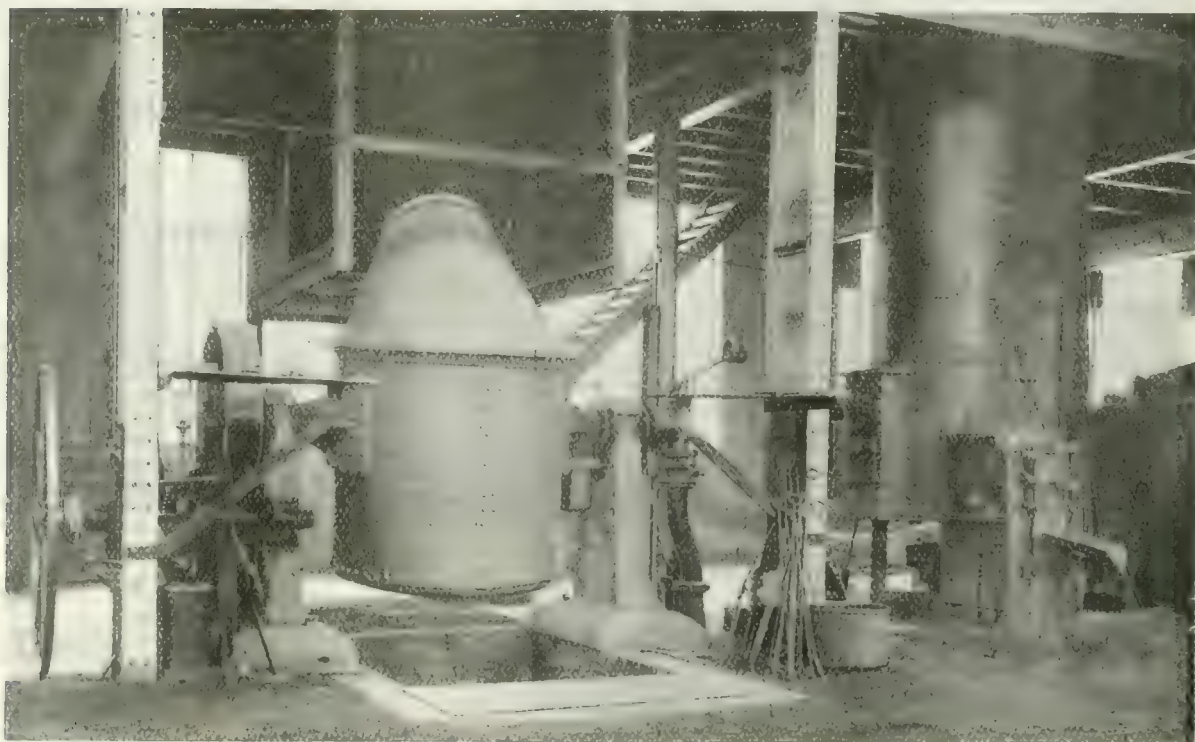
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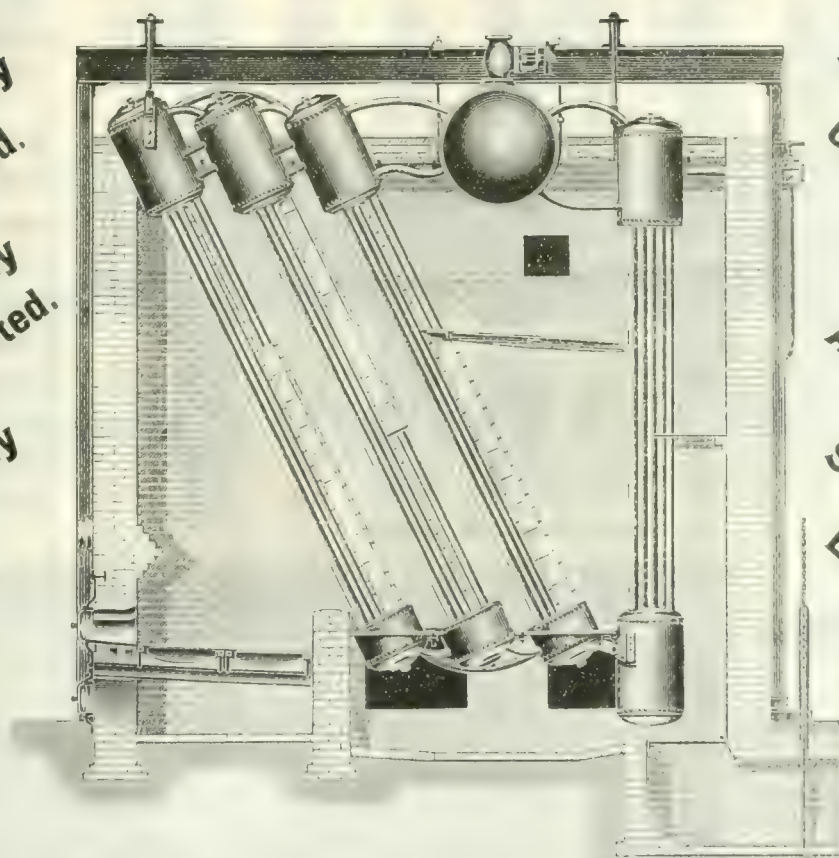
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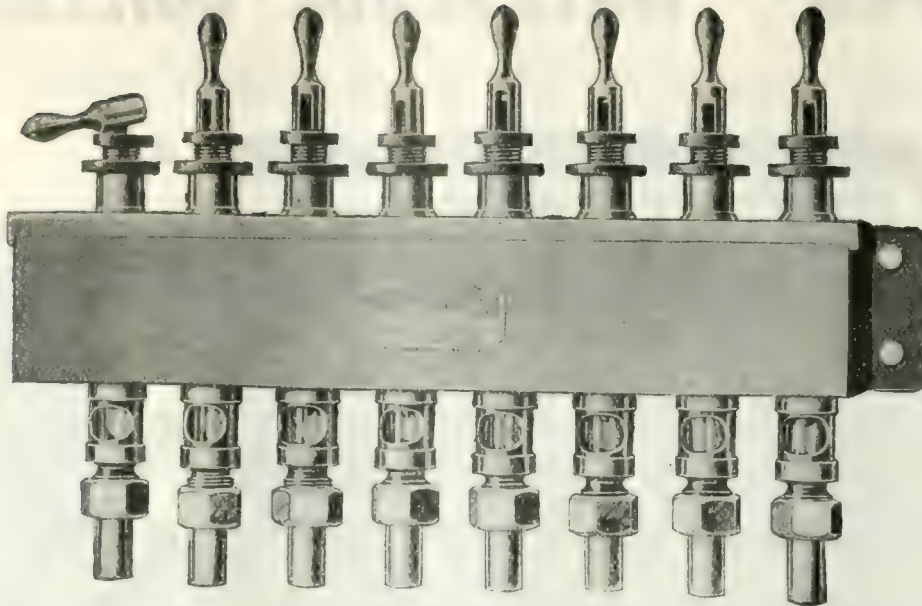
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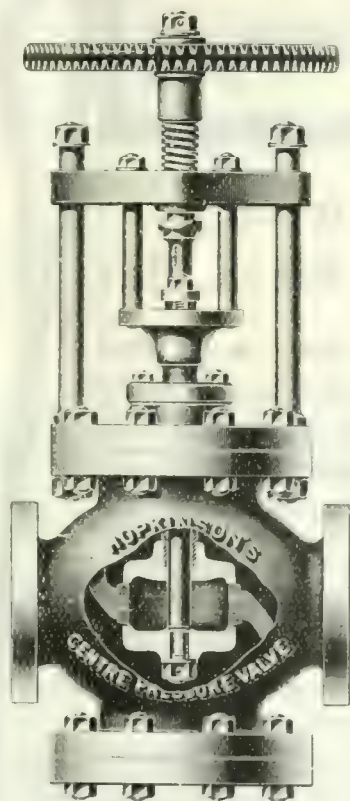
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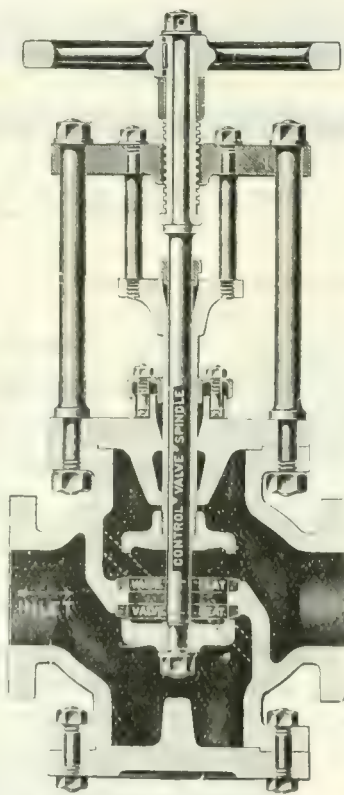
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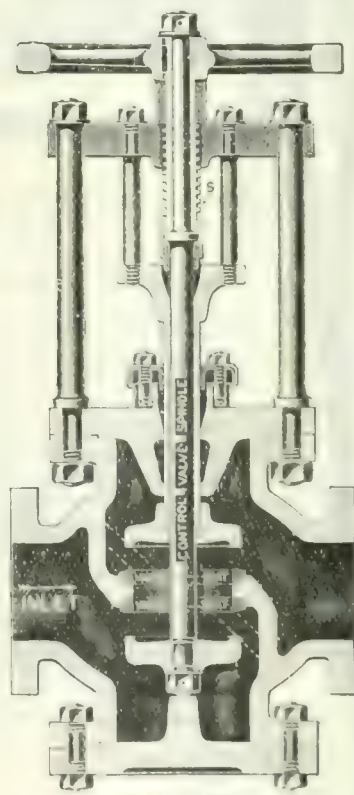
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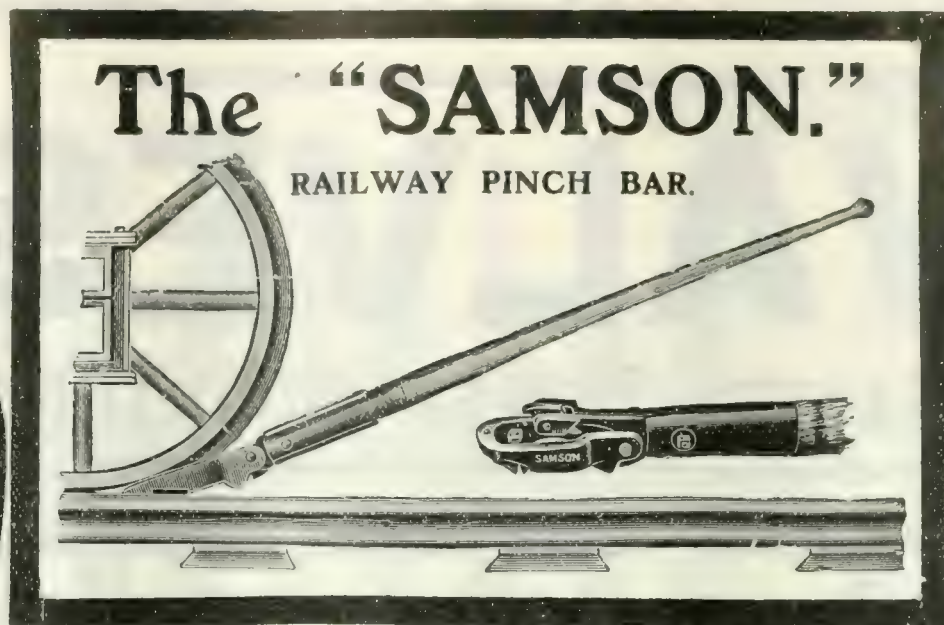
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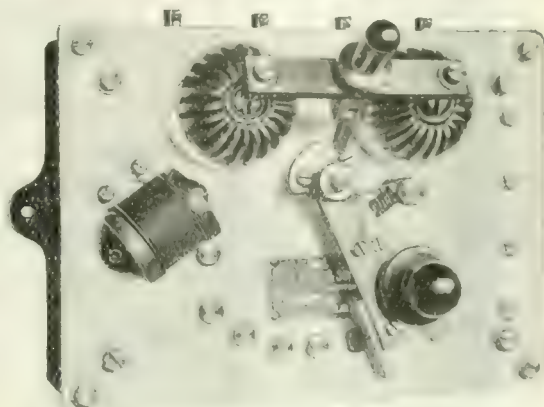
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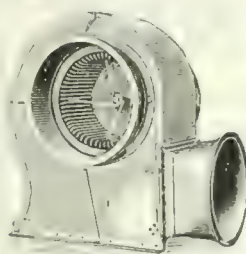
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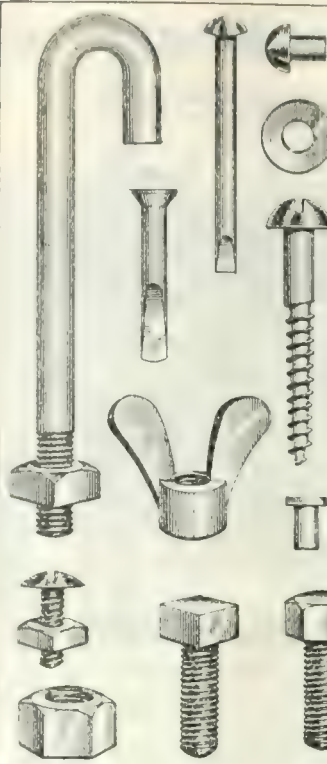
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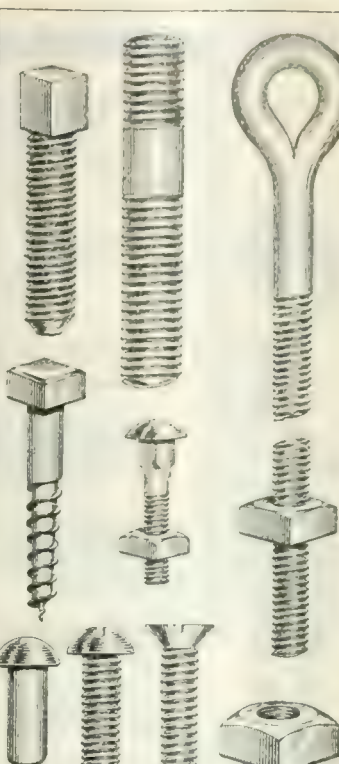
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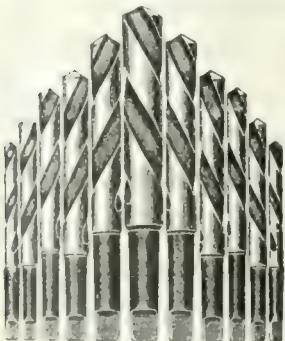
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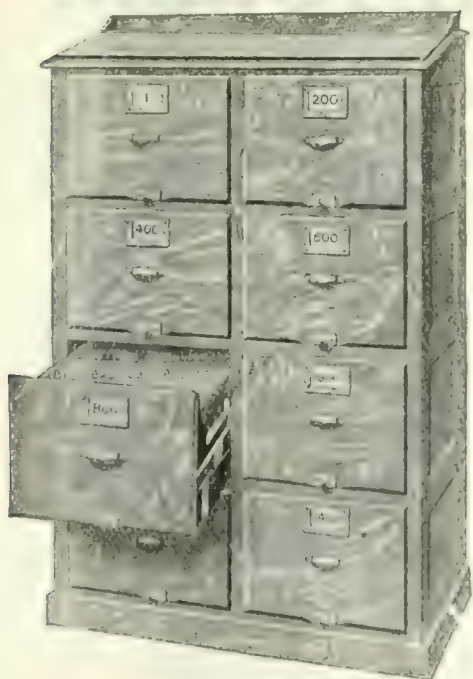
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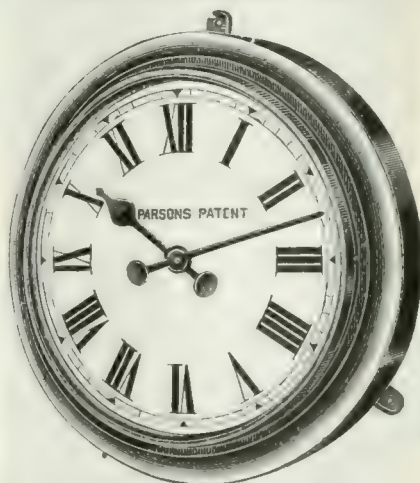
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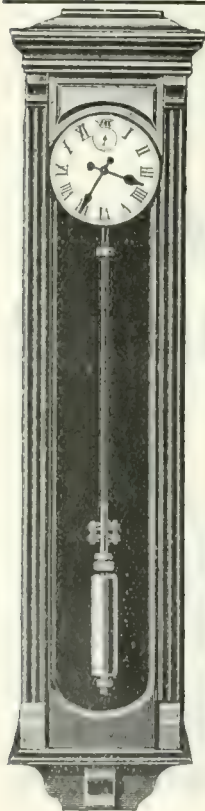
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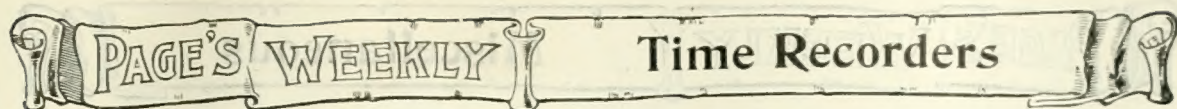
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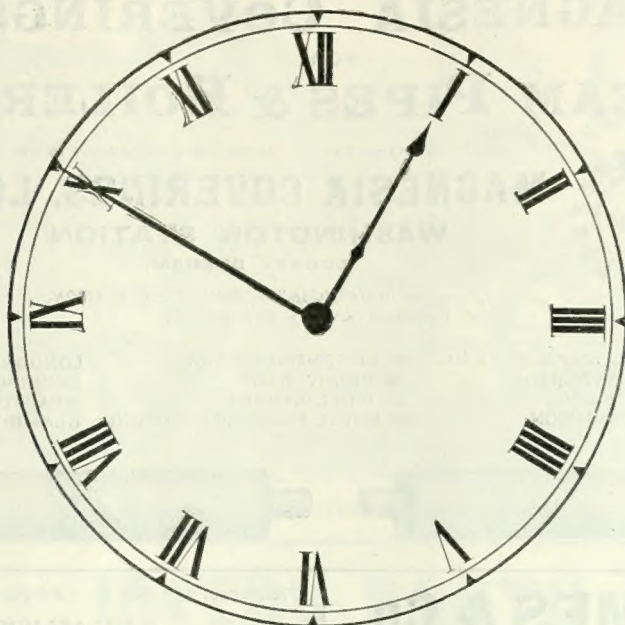
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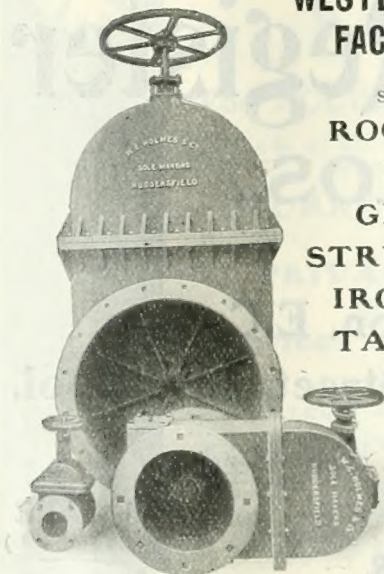
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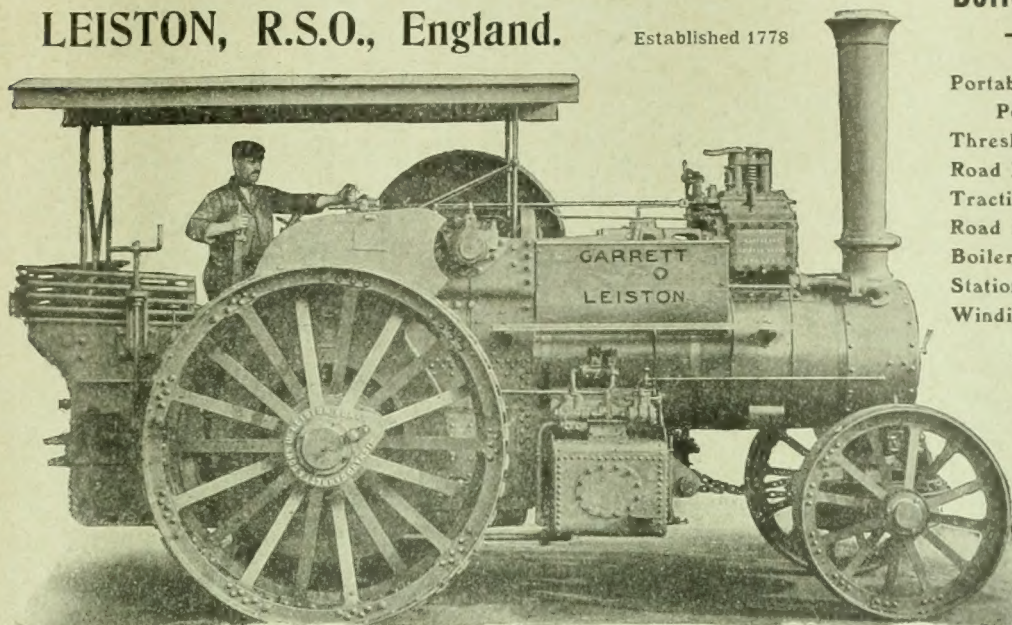
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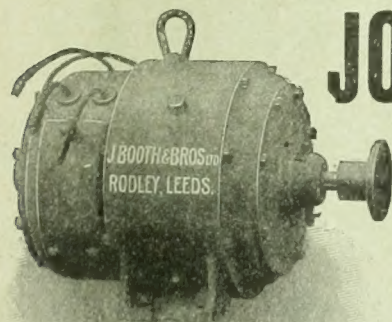
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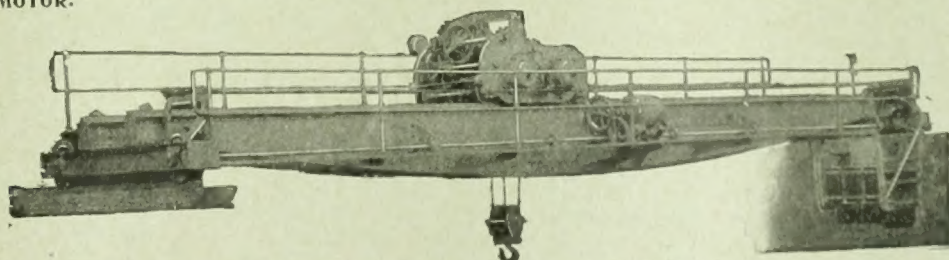
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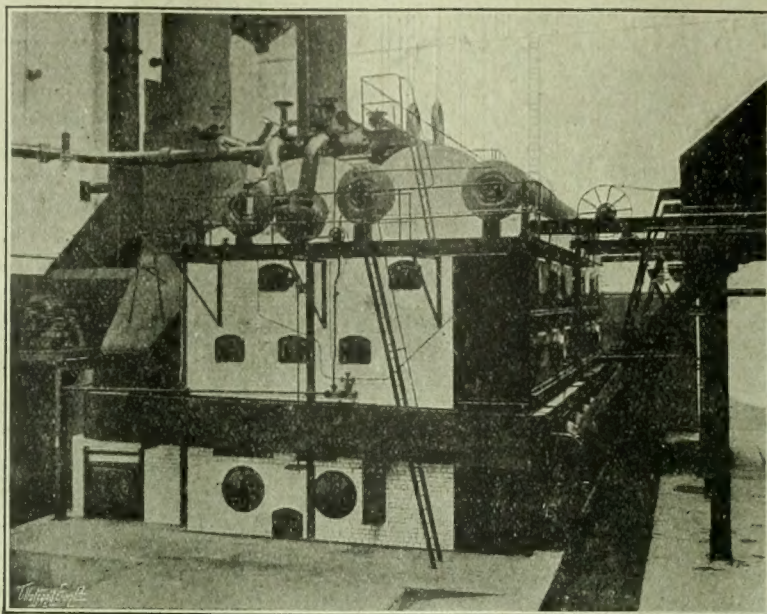
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